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Appraisal of Long-Term Credit

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Using Linear Programming

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Unit Costs Reconsidered

N.A.A. BULLETIN

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Improving B-E Analysis by Linear Programming Technique

by ROBERT K. JAEDICKE

IN RECENT ISSUES of the *Bulletin,* several major articles dealing with break-even analysis have appeared. These articles have, in general, dealt with one of the following general problems: (1) How can the break-even formula be improved? or (2) How is break-even analysis useful in managerial decision making? It seems that there is general agreement on at least two major points which are that break-even analysis is useful for both planning and reporting, and that it can be and should be improved. In all the discussions, however, one very important potential improvement—by linear programming—has been almost entirely overlooked. Linear programming, in the opinion of the author, might be looked upon as an extension of break-even analysis. The purpose of this article is to establish the relationship between these two management tools and show how linear programming can be a valuable addition to the accountant's kit of tools.

The Product-Mix Problem

One of the major problems in break-even analysis is how to deal with the product mix in a multi-product firm. In constructing a break-even chart, it is necessary to assume some product mix or product package. This has long been considered one of the problems that severely limit the usefulness of the tool.

On the other hand, break-even concepts have been found useful in making product-combination (product-mix) decisions. Break-even analysis uses the concept of marginal income (sales price per unit minus variable costs for unit). Armed with this simple but useful idea, it is possible to progress a long way toward a solution to the product-combination problem. A clear-cut solution, however, becomes difficult when the number of products is large. This situation can best be handled by linear programming and it is this situation that best illustrates the relationship between break-even analysis and linear programming.

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As an example of the product-combination problem, let us assume that the firm produces and sells two products, A and B, and that the selling price and cost data are as follows:

	Product A		*Product B*
Selling price	$10.00		$8.00
Variable costs of production and selling	5.00		6.00
Total fixed costs		$200.000	

In calculating the break-even point, it is necessary to know the sales ratio of the two products. The break-even point calculation under two different sales mixes follows:

Selling price for product package:	*Sales Mix: 2A—1B*	
Product A: 2 x $10	$20.00	
Product B: 1 x $8	8.00	$28.00
Variable cost for product package:		
Product A: 2 x $5	$10.00	
Product B: 1 x $6	6.00	$16.00
Marginal income		$12.00

Break-even sales: $\frac{200.000}{12/28} = \$466.666.$

Selling price for product package:	*Sales Mix: 2B—1A*	
Product A: 1 x $10	$10.00	
Product B: 2 x $8	16.00	$26.00
Variable cost for product package:		
Product A: 1 x $5	$ 5.00	
Product B: 2 x $6	12.00	$17.00
Marginal income		$ 9.00

Break-even sales: $\frac{200.000}{9/26} = \$577.777.$

The two different sales mixes are contrasted in the profit-volume graph shown on Exhibit 1. As can be seen, the break-even point (and the break-even chart) depends on the ratio in which the products are sold. Since Product A is the most profitable product *in terms of sales* (i.e., the profit-volume ratio for A is .50 and for B is .25), the break-even point is lower for the 2A-1B combination than for the 2B-1A combination. Furthermore, as the combination changes, the break-even point changes.

The decision maker may face a more important problem than the calculation of the break-even point. In any multi-product firm, there is the ever-present

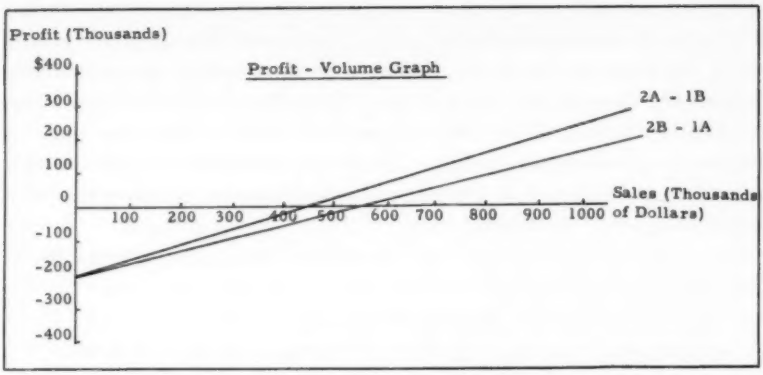

EXHIBIT 1

planning problem of deciding what combination of products should be produced and sold. Some of the established break-even analysis concepts can be very helpful in solving this problem. The planning problem is quite different, and much more difficult, than the problem of recasting the operation of past periods in the form of a break-even chart.

Suppose the decision maker must decide on the combination of Products A and B to be produced and sold in the coming period. Assume that the present manufacturing facility can be used to produce either Product A or B and that the market for both products is unlimited. These assumptions are unrealistic, but by simplifying the problem it is possible to demonstrate how break-even concepts can aid in the solution. This problem will also serve as an example to show how linear programming is related to and is a powerful extension of break-even analysis.

The Products-Combination Decision, Subject to One Constraint

The accountant has furnished the manager a very important piece of information as a result of the break-even analysis. The marginal income for Product A is $5 and for Product B is $2. Since the only difference between net profit and marginal income is the fixed costs of $200.000, the manager can maximize net profit by choosing that combination of Products A and B which maximizes marginal income. It is assumed, of course, that fixed costs are fixed over the range of volume being considered.

The decision maker can calculate an index of the desirability of each product by combining the marginal income per unit with some measure of the amount of the *scarce factor of production* used up in producing and selling each product. Assume, for example, that Products A and B can be produced and sold in any combination, subject to one very simple constraint, i.e., that there are only 400,000 production hours available. If each unit of Product A requires 4 hours to produce and each unit of B requires 1 hour to produce, the following profitability indexes can be computed:

	Product A	*Product B*
Marginal income per unit	$5	$2
Hours of production time required per unit	4	1
Profitability index: Marginal income per hour	$1.25	$2.00

In this simple example, the decision maker would prefer Product B to Product A. In fact, if not for other constraints, Product A would never be produced. This can also be seen from a profit-volume graph. In Exhibit 2, both selling plans are plotted on the profit-volume graph. The break-even sales are $400,000 if Product A is sold and $800,000 if Product B is sold. Profitwise, in spite of the higher break-even point, Product B is more desirable. This may appear contradictory but it must be remembered that, given the production constraint, it is possible to produce and sell only 100,000 units of A. On the other hand, if Product B is chosen, it is possible to produce and sell 400,000 units. As shown in Exhibit 2, at $1,000,000 sales for A, the profit is $300,000; however, at sales of $3,200,000, selling Product B, the profit is $600,000. Hence, B is the more desirable product.

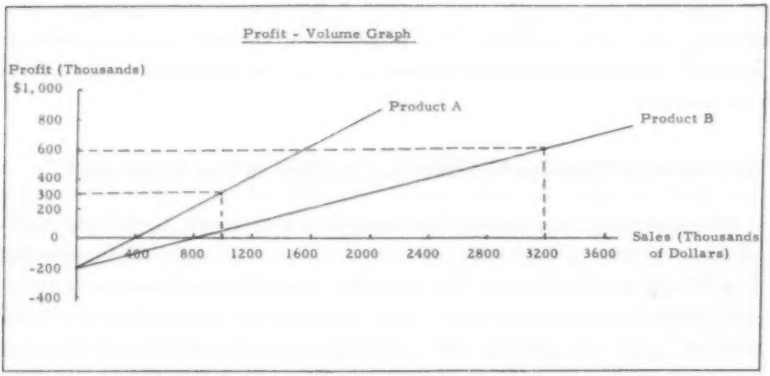

EXHIBIT 2

In situations where there are few products and few constraints, the marginal income per production hour is a perfectly satisfactory index to use in approaching combination problems. The production hour is used as a measure of the scarce factor; thus the index can be generalized by calling it the *marginal income per the scarce factor.* The scarce factor may change from situation to situation but, so long as there is only one, the above approach will suffice. Consider, for example, the capital allocation problem. In deciding how to allocate capital to competing investments, one criterion frequently used is the rate of return on investment. In this instance, the cash flow is a type of marginal income calculation and the capital requirement for each project is viewed as the scarce factor. As another example, consider the problem of deciding how to utilize additional floor space in a supermarket or department store. The marginal income per square foot of floor space for each competing line of products may be a perfectly adequate index to decide how the additional space should be used. In this case, the scarce factor is floor space.

One obvious difficulty with the above method (which is developed essentially from break-even analysis) is that there may be many constraints rather than just one, i.e., that of production time. Also, there may be more than two products. Under these conditions, traditional break-even analysis is inadequate but linear programming can be used to find a solution. The concepts of break-even analysis remain unchanged; the major difference is that linear programming allows for many different products and many different constraints (or scarce factors) and thus goes beyond the traditional analysis. However, many of the decision problems which accountants and decision makers are interested in can be solved by applying both break-even concepts and linear programming.

A Linear Programming Solution

The simple example discussed above can be formulated as follows:

Maximize: Marginal income $= \$5A + \$2B$
Subject to: $4A + 1B \leq 400{,}000$

This statement of the problem is consistent with that of the typical linear programming problem. This general formulation has several important characteristics. First, the problem is to maximize some function, usually called the objective function; in our case the function represents the marginal income for the future period. By deducting fixed cost, the objective function can be converted into the profit function. In another case, the problem might be to minimize some objective function. Hence, problems of minimizing cost can also be solved by linear programming techniques.

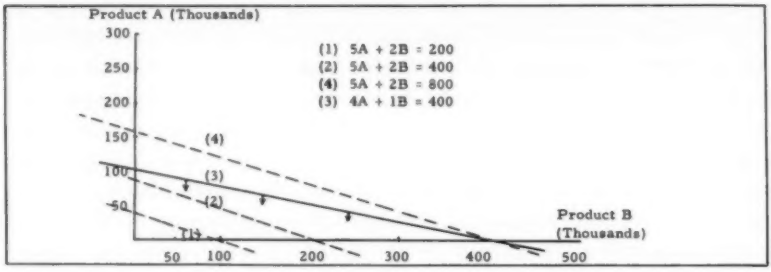

EXHIBIT 3

A second important characteristic of the formulation is that the objective function is to be maximized *subject* to constraints. In the example, the only constraint is that the number of hours used to produce A and B must be less than or equal to the total production hours available—400,000. In general then, the problem is to find a solution that will make marginal income as large as possible and consistent with whatever constraints are imposed. In this simple example, the linear programming problem can be solved graphically.

In Exhibit 3, the products are plotted on the two axes. The equation, $4A + 1B = 400$ is plotted and this line together with the respective axes gives an area which contains all feasible solutions. These solutions are feasible in that they will satisfy the constraint that the number of hours used must be less than or equal to 400,000. The objective function can be plotted by assuming several different amounts for marginal income. This has been done for marginal incomes of $200,000, $400,000 and $800,000. The problem is to maximize the objective function, which means to move the marginal income line upwards to the right. The objective function is restrained by the inequality $4A + B \leq 400{,}000$ and the intersection at 400,000 units of B and zero units of A will then give the highest possible marginal income. The marginal income line cannot be moved any more to the right since this would call for solutions which are outside the set of feasible solutions as defined by the production constraint.

Additional Constraints

The foregoing example is unrealistic in the sense that only two products and one constraint were assumed. What happens when more constraints are added? The traditional break-even solution is inadequate but the graphical linear programming solution will work. Suppose, for example, that the maximum number of units of B that can be sold is 300,000. In other words, there is a market

as well as a production constraint. The new formulation and graphical solution are as follows:

$$\text{Maximize: Marginal income} = 5A + 2B$$
$$\text{Subject to:} \quad 4A + 1B \leq 400{,}000$$
$$B \leq 300{,}000$$

As shown in Exhibit 4, the best product mix would be 300,000 units of B and 25,000 units of A for a total marginal income of $725,000. So long as there are only two products, the graphical linear programming solution will suffice regardless of the number of constraints imposed.

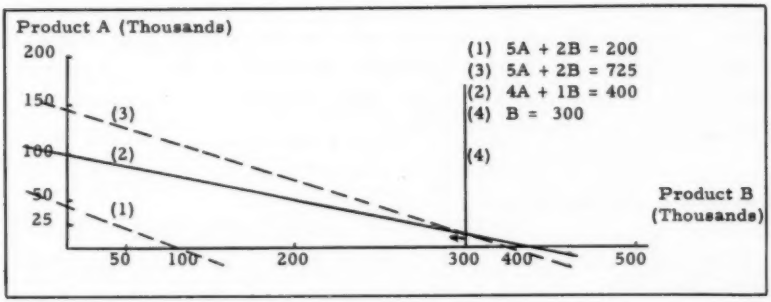

EXHIBIT 4

Many Products and Constraints

The real power of linear programming, as an extension of break-even analysis, becomes apparent in the case where there are several products and constraints. In a situation where more than two products are involved, the graphical solution is not useful since diagrams in several dimensions are impossible to work with. In the many-product, many-constraint case an algebraic method of finding a solution is necessary.

The general form of the linear programming problem with many products and many constraints can be written as follows:

$$\text{Maximize: Marginal income} = C_1 X_1 + C_2 X_2 + \ldots + C_n X_n$$
$$\text{Subject to:} \quad = A_{11} X_1 + A_{12} X_2 + \ldots + A_{1n} X_n \leq B1$$
$$= A_{21} X_1 + A_{22} X_2 + \ldots + A_{2n} X_n \leq B2$$
$$A_{m1} X_1 + A_{m2} + \ldots + A_{m^n} X_n \leq B_m$$

In the above formulation of the problem, the firm has $_n$ products where $_n$ is some large number. These products are X_1, X_2, through X_n. The contribution

or marginal income of each product is indicated by the C coefficients, C_1, C_2, through C_n. The total marginal income is a summation of the contributions per unit times the number of units of each product sold. Note that if there are only two products, the general formulation of the objective function reduces to an equation like the one in the example, $\$5A + \$2B =$ marginal income.

The constraint inequalities represent several possible production or sales constraints. There are $_m$ such constraints and each constraint involves $_n$ products. In case there is just one constraint, and two products, the set of inequalities reduces to an inequality like the one in the example, $4A + 1B \leq 400{,}000$.

The problem is to find a solution, i.e., values for the X's which will make marginal income as large as possible and at the same time will satisfy all $_m$ constraints. The graphical solution will not work because there are more than two products. However, a mathematical solution technique known as the simplex method will work. This technique has been programmed for electronic computers and a computer solution is possible.

Summary and Conclusion

It has long been recognized that break-even analysis and break-even concepts are useful in certain decision problems. In this article, the example used is a product-combination problem. Another example that would have served equally well is the problem of factor combination, that is, finding the least-cost method of production. In either problem, the prime ingredients are the marginal income of each unit of product and a statement of the scarce factors, that is, a statement of the production and sales constraints.

The accountant has made an important contribution in the break-even analysis area. This technique can be used to handle many problems, especially where there are only a few products and constraints. Break-even analysis breaks down in a situation with many products and many constraints. In the author's opinion, it is time for accountants to begin looking to linear programming as an extension and an improvement of a useful but limited type of accounting analysis. All the necessary ingredients of a linear programming problem are well known by accountants with the exception of the mathematical solution techniques. In simple problems, the graphical method of solution will suffice. This method is simple and can be easily understood. The difficult problems will be solved by using the simplex method and a computer. There is no reason why the accountant needs to know and understand all the details of the solution technique before he adds linear programming to his kit of tools. In the last analysis, this tool is very closely related to many of the tools already in the kit.

The Industrial Engineer and the Cost Accountant

by SAM E. SCHARFF

FOR THE PURPOSES of this paper, it might be well to try to define industrial engineering right at the start. There are three basic or primary functions of an industrial engineer:

1. To find the "best" way or method to do a job or to perform an operation.
2. To determine how long it should take to do a job or perform an operation.
3. To coordinate and schedule the activities of the several entities or departments which take a part in producing the product, in such manner that a minimum of delay is encountered.

What the Engineering Functions Consist Of

The first of these functions involves many things and interlocks with the duties of other specialists, particularly the product design engineer, the tool engineer and the plant engineer. Among things involved are:

1. Plant layout—the locating and arranging of equipment, tools and facilities to facilitate the flow of work and the control of operations, and to reduce the handling and transporting of material, work in process and finished goods to a minimum.
2. The selection of best-suited tools and equipment, and the design of jigs, fixtures and other production aids.
3. The adaptation of product design to more efficient methods or tooling.
4. The design of individual work stations.
5. Detailed methods and motion studies of individual operations.
6. Training of workers in the use of proper methods.

The second of the industrial engineer's functions (determining "labor standards") should follow a methods improvement program. In performing this function the industrial engineer frequently uses time study techniques originated

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by Frederick Taylor back in the 1880's. These techniques have been refined considerably in recent decades and may be used with confidence in many circumstances. However, there is an element of judgment involved, and careful training of time study technicians is a necessity.

In recent years the technique of time study has been combined with the technique of motion analysis to yield systems of predetermined time data. Through the use of these data it is possible to analyze methods and to derive labor standards as a by-product of methods improvements. The data can also be used to set labor standards for existing operations without the methods analysis approach being considered primary. Certain techniques which utilize sampling and statistics have been developed recently and can be used in this area. Labor standards set by any one or any combination of these techniques can be used for:

1. Estimating or determining selling prices.
2. Standards for a standard cost accounting system.
3. Labor control at the operating level.
4. Master scheduling.
5. Detailed shop scheduling.
6. Wage incentive systems.

From this tabulation it is evident that a labor standards program should usually precede the development of a detailed scheduling procedure, which is part of the third basic function of the industrial engineering—coordinating the entities involved in production. This coordinating function is normally referred to as production scheduling and control. Usually there are two phases of it:

1. The master scheduling phase, which seeks to coordinate the activities of purchasing, material control, engineering, drafting and other contributing entities to provide the plant with whatever is needed to manufacture the product at the time it is needed. Woven into the fabric of the master schedule is also a crude allocation of shop capacity.
2. The detailed scheduling phase, or the loading of the several shop departments, tools, machines, etc. This is to achieve maximum utilization of facilities and manpower, with as few delays as possible.

Beyond his three basic functions, the industrial engineer is concerned with many things. To mention a few:

1. Inventory controls as they relate to production scheduling and control.

2. The determination of economic lot sizes.
3. Quality controls.
4. The design and installation of wage incentive plans.
5. Foremen training.
6. Feasibility and economic studies of all kinds.

Perhaps this description of functions and techniques is sufficient to define industrial engineering for present purposes. There is another, briefer definition, and one which enjoys a degree of official recognition. In 1955 the American Institute of Industrial Engineers published the result of a lengthy effort on the part of a special committee to define industrial engineering. This result was accepted and approved by the body politic of the institute, and is as follows:

> "Industrial Engineering is concerned with the design, improvement and installation of integrated systems of men, materials and equipment. It draws upon specialized knowledge and skill in the mathematical, physical and social sciences, together with the principles and methods of engineering analysis and design to specify, predict, and evaluate the results to be obtained from such systems."

Keys to Areas of Disagreement

The definition cited may not be the best definition in the world, and it is (in my opinion) incomplete in certain respects. However, it will serve to indicate two things:

1. The principal area in which the practice of cost accounting and the practice of industrial engineering overlap.
2. The principal difference or the "line of demarcation" between cost accounting and industrial engineering.

The word, *evaluate,* is the key to the principal area of overlap. Certainly the objective of an industrial engineer is a profitable operation. Equally certain is the fact that the cost accountant is responsible for evaluating, or attaching dollar amounts to, the several elements of cost or expense which result in a more or less profitable operation.

Thus the cost accountant *and* the industrial engineer are frequently compiling cost figures covering the same items. That these figures seldom agree does not nullify the fact that this area is occupied jointly by the cost accountant and the industrial engineer.

The word, *predict,* is the key to the principal difference or the "line of demarcation" between the cost accountant and the industrial engineer. A com-

petent industrial engineer can predict (with reasonable accuracy) the results to be obtained from a given operation under a given set of circumstances, regardless of what experience data may or may not be available. A cost accountant is not often equipped to make such predictions without the benefit of considerable historical data, although, astonishingly, many attempt to do so.

Perhaps these similarities and differences can be re-expressed more simply:

1. The industrial engineer is continually trying to determine how much a given item or operation *should* cost, and frequently compiles figures to determine whether or not operations are "up to snuff" and whether or not his predictions were reasonably accurate.
2. The cost accountant is compiling a record of costs which may or may not have the same break down, limits and philosophy as those compiled by the industrial engineer, and which may reflect an entirely different result.

Needless to say, these two individuals are frequently at odds with each other. Perhaps an explanation of their divergent viewpoints might enable each to realize that his opponent is not completely unreasonable.

All too frequently the engineer does not realize that the cost accountant's work, the systems he establishes and the reports he compiles from them, fall within the framework of, are tied-in to, and cannot exceed certain limiting factors of the general accounting system of the company. All too frequently the engineer does not realize that cost accounting systems are generally designed to function on a continuous basis, that they are not designed to yield minutely detailed information and that, therefore, the results must be taken for what they are—control pictures painted with a relatively broad brush for the benefit of managers who usually want to manage through the "exception principle." Systems capable of pinpointing costs in minute detail (as are frequently desired by the engineer) would be so complex and unwieldly as to strain the capacity of both man and machine, even in this day of electronic computers. Further, such detailed information is seldom (if ever) needed on a continuing basis, at least in relation to any one problem or small segment of a plant which might interest the engineer at one time or another. True, an engineer might desire such detailed information almost continuously, but one week his desire would pertain to a given drilling operation, the next week to electroplating, and the next month to stress relieving. Seldom would there be a continuing desire in relation to a single problem.

Labor Costs of Jobs—Time Recording

Perhaps it would be well to get a little more specific and cite some examples

of matters on which the engineer and the accountant are apt to disagree. Let us consider the problem of labor costs. Substantially all labor costs as determined by the cost accountant are based on labor hours spent by various individuals on any given job or operation as shown by a pay roll classification system or by some method of labor time reporting. In the process-type industries the pay roll classification approach is frequently adequate for many cost accounting purposes. It is usually not adequate for industrial engineering purposes. In most shops which manufacture rather than process goods and particularly in job shops, some form of labor reporting is essential in a very large majority of instances if any reliable cost accounting or industrial engineering information is expected. There are many different systems in use for reporting labor hours. However, they fall into two general categories:

1. Systems in which each workman reports his own time.
2. Systems in which a timekeeper reports the time of workmen.

I believe that the cost accountant is too prone to take the results at face value, regardless of the category the system might belong to. He is, in general, unaware of the inaccuracies, both intentional and unintentional, which creep into any such system.

Several years ago a study was made of time reporting in the shops of a large steel and alloy plate fabricator to determine to what degree the time reporting was accurate, what kind of errors were being made and what was the probable cause of these errors. In this company's time reporting system each workman reported his own time. Our findings revealed that the time reported against any job could vary as much as 15 or 20 percent from actual time without it being detected by the foreman's checking of time cards at the end of the day or by other checks, such as comparing estimated with actual hours, etc.

We found that the two most glaring sources of variances were, first, inadvertently charging time to the wrong job and, second, willfully charging time to the wrong job when it was obvious that a given job was running over the estimated hours. There were numerous reasons for this being so, from improper identification of the material being worked on to workmen covering up excessive personal time. In all, there were some twenty-five sources of error identified.

It is my belief that the industrial engineer is much more sensitive to possible errors in such source documents than is the average cost accountant, due to the fact that he is present in the shop for long periods and has a chance to become familiar at first hand with the practices of the various workmen in relation to their time-keeping. He knows the futility of trying to get time reported accurately in small increments and knows very well that the human element will

generally lead the workmen to report their time in such a manner as to cause themselves the least bother and that they will often cover up deficiencies of their own. For this reason, the industrial engineer is apt to have an inherent distrust for time-keeping systems, particularly those in which each workman reports his own time. This distrust has led him to seek more reliable data through other procedures, which are actually separate time-keeping attempts over a limited period of time. Or, he has resorted to statistical methods of determining how workmen spend their time. In some such manner, he will arrive at labor figures which, frequently, will vary considerably from those derived by the cost accountant from the time records of the shop. The industrial engineer is prone to give more credence to his data, even though it may not, in all instances, be substantiated by being proved against some control figure.

These divergent viewpoints frequently cause misunderstandings and arguments. This is unfortunate because actually both the engineer and the accountant are right within the limits of their respective philosophies and data gathering methods.

Labor Costs of Jobs—Wage Rates, Overtime

An additional point on which the cost accountant and the engineer clash in the area of labor costs is the tendency on the part of the cost accountant to insist that labor hours charged to any job, operation, or account, should be converted into dollars by the use of individual wage rates. It is natural that the cost accountant should desire a procedure that will enable him to distribute a pay roll accurately and balance it out against a specific pay-roll amount.

To the industrial engineer such a procedure is frequently undesirable. This is particularly true in job shops. The engineer's reasoning is along these lines: In estimating the cost of a job in order to determine a selling price, standard or estimated hours are converted into dollars by using one or more average wage rates. In costing out a job, the same wage rate or rates should be used as were used in estimating, in order to get a true comparison of estimated costs with actual costs. It seems obvious to him that the average wage rate approach is necessary for estimating because it is not known at the time of bidding which man, or men, will actually perform the work. And it seems obvious to him that this makes very little difference since the more skilled mechanics will draw a higher wage rate and will produce more than the less skilled. Therefore, in his opinion, the desire of the accountant to go through the tortures of using individual wage rates is inexplicable. Even where tabulating equipment is available, which frequently makes extensions by individual wage rates simpler than by average wage rates, the engineer may protest against the procedure.

There are means of using average wage rates for labor hours, which utilize a very simple procedure in order to correlate exactly the total dollar amount distributed against the total dollar amount paid on the pay roll. This procedure is an offshoot of the standard cost approach and consists of charging the difference between the pay-roll amount and the amount distributed to a variance account, or to some indirect labor account. The "fly" in this ointment is usually overtime premium pay. There are two approaches to reconciling the presence of overtime premium pay with an average-wage-rate distribution system:

1. Include in the average wage rate, or wage rates, an "average amount" of overtime premium pay. If this is done, the variance between the amount distributed and the actual pay-roll amount is likely to be larger than is desirable and debits or credits to the variance account will be quite sizeable at certain periods.
2. Screen off the overtime premium pay, charge it to a burden account, and base the average wage rate, or wage rates, on straight-time rates only. Il this is done, variances will be of a much smaller magnitude and will seldom warrant the use of a separate variance account, since the amounts involved may be charged to an indirect labor account without distorting the cost picture. This will enable an exact distribution of the pay-roll amount.

The cost accountant may question the practice of charging all overtime premium pay to an overhead account. His basis may be that a customer who is in a rush for a job—and it requires overtime work—should pay for it, and the cost record of the job should reveal it. The industrial engineer will be heartily in agreement with the philosophy that the customer whose urgency caused overtime work should be required to pay for it. However, he will not be in favor of the individual job bearing the cost of the overtime premium pay. There are a number of reasons for this:

1. It is frequently necessary, particularly in a job shop, to spend overtime on John Doe's job in order to get it out of the way and clear machines and other facilities so that Tom Smith's rush job may be produced as desired, during normal working hours. In such instances, John Doe's job would be charged with overtime even though Tom Smith should be paying for it.
2. The charging of overtime premium pay to any job distorts the cost comparison between estimated and actual costs.
3. Overtime is frequently used as a means of increasing productivity of a plant during rush periods when no single job is any more urgent than any other job. In such instances, it is purely and simply an additional operating expense and it is entirely coincidental that the money goes to productive labor.

For these reasons, it is usually desirable in manufacturing operations to screen off overtime premium pay and to consider it as a burden factor, rather than charge it to individual jobs, operations or accounts, even though individual wage rates may be the means of extending labor hours. There are means of determining and recording overtime hours spent on John Doe's job which should be charged to Tom Smith, and it is, of course, desirable to make such charges.

Material Costs of Industrial Jobs

Let us now consider the problem of material costs. The accountant is constantly faced with keeping a general ledger inventory account straight, of putting into and taking out of inventory given items of material at the same unit cost. It is surprising to see how far some people will go in attempting to keep their inventory account straight by rigidly adhering to some such system as the first-in first-out, average cost, etc. I might say also that they fall into traps due to a failure to fully appreciate certain technicalities relating to a given item of inventory.

Let us take, as an example, the problem of steel plate. When steel plate is rolled at the mill it does not come out as a perfectly flat sheet of true rectangular cross section. The rolls and shafts of the mill distort under the tremendous pressures involved in the rolling, with the result that the plate is thicker at the center than it is along the edges. Since plate is rolled to a nominal thickness, it is seldom less than that thickness at the edge. Therefore, almost always steel plate weighs more per square foot than the theoretical weight of a plate of steel of true rectangular cross section. This overweight or "mill tolerance," as it is called, can amount to as much as ten percent or more under certain circumstances. The steel mills invoice plate to their customers on a scale-weight basis, rather than on a theoretical weight basis. The result is that plate of any given thickness and selling at (say) 6½¢ per pound will vary in cost from one shipment to the next

It is surprising to see the gyrations through which some accountants will go in order to try and keep their inventory figures straight and to cost out the product on the basis of what the steel actually cost. I have seen them try to maintain separate weight and unit-cost-per-pound figures for each plate delivered by a mill. This is, of course, pursuing the problem to absurd lengths and is by no means common. However, the costing of steel plate on a poundage basis is relatively common.

There are certain basic factors which have been overlooked:

1. For any given quality of steel, one-half inch plate is one-half inch

plate from the standpoint of the design engineer, regardless of how small or how large the mill tolerance might be.

2. It is necessary in some instances for the design engineer and the shop to maintain an accurate record of the source of the steel plate used for any given product or component, in order to be able to identify it with certain chemical analyses and strength tests that are run by the mill on each heat of steel produced. The maintenance of such records is not necessary for all components and would not enable the shop or the engineering department to identify the steel used for any component with any individual plate.
3. Complete plates are not used all at one time in all instances. Frequently a component may be fabricated from the drop-off of a plate that was used several months ago.

For these and other reasons the shop and the engineer are frequently up in arms at requests by cost accountants for detailed identification of plate used for specific purposes. There is, of course, an easy answer, but it is surprising how difficult it is to convince some accountants that it will hold water. The solution again involves the standard cost approach. An analysis of a representative sample of mill invoices will reveal the average mill overrun for any given thickness and width of plate. When this is determined, it is possible to put a unit price on a square foot of plate and consider it in exactly the same manner as one would consider a standard cost on any other material item. At the time invoices are received, any price variances due to too low or too high a mill tolerance or to a change in unit price per pound, or in freight rates, can be screened off and expensed. If this is done, it is possible to cost out material and to relieve inventory on the basis of the number of square feet of plate used and the standard unit price per square foot, without regard to the number of pounds of steel used and without regard to identifying the plate in relation to any mill purchase or invoice.

Such a procedure is compatible with any of the recognized methods of evaluating inventory for tax purposes, as long as the standard unit prices are adjusted to that method at the year's end. Normally such unit prices would be used during the ensuing year without change, unless some significant change in the market indicated the desirability of modifying them to achieve a more realistic inventory figure.

Raw Material Inventory

Another thing which frequently causes differences between the cost accountant and the engineer is the matter of inventory control records. To the accountant

these records are a subsidiary to the corresponding general ledger account and he wants as exact a correlation between them as possible. To use the steel plate example again, the cost accountant is apt to want to use requisitions or cutting tickets as the basis for relieving inventory records as well as the general ledger account. He is likely to ask for detailed information on dimensions of pieces used and pieces remaining. He is likely to want to maintain detailed records of remaining pieces by actual dimensions of individual pieces. Only by such data can he obtain the asset value accuracy he desires. To the engineer concerned with production scheduling and control problems, the inventory records serve an entirely different purpose. To him they are the source of information on the *availability* of material at any given time. Do we have enough steel plate for this job or must it be purchased? Through this information he can determine time factors for scheduling which are most important to him. One would think, then, that he would be heartily in favor of detailed records by dimensions of drop offs, etc. This is not so. His reason for not wanting them is that he knows he cannot trust them. He has found that the theory and the practice of this idea are two different things.

For instance, when the material control unit issues instructions to the shop to cut steel for a given part from a drop-off 65½" x 43¾" in size, as shown on the inventory records, one of three things can happen:

1. The shop will do so and report accordingly. However, this will happen only if the shop can find the drop-off specified and is willing to shift plate around and measure pieces until it has identified the right one.
2. The shop will use another drop-off or a new plate and will report accurately what has been done.
3. The shop will use another drop-off or a new plate and report the use of the drop-off originally specified.

Unfortunately the last alternative is more apt to happen than either of the other two—the first possibility (following instructions) is too time-consuming and too much trouble, the second brings down the wrath of "the office," so the third happens too often to allow for a reasonably accurate set of records.

This controversy is somewhat aggravated by the additional question, which might be stated as follows: If we cut this part out of a given piece of steel and leave a drop-off, how much should be charged to the job, and how much should remain in inventory as the value of the drop-off? In other words, what is the chance of using the drop-off economically on some future job?

One solution which appeals to the engineer is to carry only whole plates on the detailed inventory records, and not depend on drop-offs for production plan-

ning. When this is done, the shop will report only whole plates cut into, as being used. Then the cost accountant is in a quandary as to how to determine the material cost of a given job. On Job A three whole plates may have been cut into. The total area in those three plates may have been 480 sq. ft., even though the job required only 300 sq. ft. On Job B only one whole plate may have been cut into. That plate area may have been 160 sq. ft., even though the job required 240 sq. ft. In other words Job A built up the stock pile of drop-offs, while Job B depleted that stock pile.

One answer which the engineer is likely to bring forward is: Why not use the bill of material as the basis for costing the job and relieving the inventory account? If we do this, we do not have to worry whether whole plates or drop-offs were used. In many instances this is an excellent solution to this type of problem. The use of the bill of material in this manner and with discretion can give more accurate job costs and greatly simplify the paperwork incidental to most inventory control and cost systems. It is, of course, necessary to provide for the accurate reporting of spoiled material, etc., which would not be revealed by a copy of the bill of material.

Guide-Posts to Cooperation

These, then, are some of the specific problems which arise and which cause cost accountants and industrial engineers to disagree.

There are probably a large number of readers who are wondering why, in discussing the common ground of the two skills, I did not launch directly into a discussion of standard cost accounting systems. Certainly it is in the design, application and operation of such systems that the cost accountant and the industrial engineer complement each other to the greatest extent and work together most harmoniously and effectively. Certainly a good standard cost system, the joint product of a capable cost accountant and a competent industrial engineer, is the apex of today's possibilities in this field. There are a number of reasons why I did not approach my subject in this way. In the first place, standard cost systems have been discussed and re-discussed from all angles. However, there are more important reasons:

1. Each example that I have cited contains one or more standard cost concepts. My desire has been to illustrate by specific examples how such concepts can be used in conjunction with the "garden" variety of historical cost accounting system and give answers which will withstand the probing of the theoretical accountant and auditor, fulfill the practical needs of people responsible for operations,

estimating, etc., and still simplify the procedures and work of the cost accountant.

2. I have tried to stress problems which must be solved through an intimate knowledge of what happens in the shop, in the estimating department, and in the engineering department. My prime criticism of cost accountants is the strange affinity of the seat of their pants for a chair behind a desk. I would hasten to add that some industrial engineers suffer from the same malady. Be that as it may, my experience with cost accounting systems indicates that perhaps 90 percent of their deficiencies is due, not to a lack of accounting knowledge on the part of their designers, but to a lack of knowledge of the technicalities of the operations being covered by the system.

Perhaps it is too much to ask that a cost accountant also be a good industrial engineer or that an industrial engineer be a good cost accountant. I do not believe that is too much to ask of either that they work together—that each supplement the other's knowledge and skill to the end that their joint efforts produce the best cost accounting available today.

Measuring the Profitability of Extended Credit Transactions

by W. JOSEPH BLOOD

MUCH EMPHASIS in recent years has been placed on the use of discount techniques for measuring return rate on proposed plant and equipment expenditures. The bankers, of course, have used the discounted-cash-flow technique for years. On a lesser scale, other types of major cash outlay, such as research and development, have been similarly exposed to this means of appraisal, but some seemingly obvious areas of application have remained subject to less valid approaches. One of these is the evaluation of long-term industrial credit situations in which the investment ultimately must be justified by the over-all return on the transaction.

A long-term credit deal is conventionally recorded to show profit from the sale itself on which we (presumably) take a mark-up, and from the extension of credit at a given interest rate, which, if in excess of our own borrowing cost, produces another gain. While we recognize that this sort of transaction dilutes our investment return, the bookkeeping involved disguises the real extent of the dilution. This largely evolves from the convention of booking a "profit" when the sale is billed and considering the booked notes as our investment. If we adhere to the real economic facts, however, the financial characteristics of a deal involving long-term credit will summarize as follows:

1. A build-up of working capital investment through a relatively long manufacturing cycle, e.g., three months. In other words, the cost that we have put into the job really is the investment that we are aiming to recover and on which we expect to make the profit.
2. Return *of* (not *on*) this investment in the form of interim principal and interest payments over a relatively long time period. In essence, then, the interest payment constitutes part of the return of cost (to the point of complete cost recovery).
3. Finally, realization of profit after the investment has been returned, i.e., usually profit is not realized until the last few note payments.

Cash Flow and Discounting

Applying some numbers to the considerations outlined above, let us look at

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a typical long-term deal:

1. An investment in working capital of $800,000 over the three month in-process cycle.
2. Sales value of $1 million with 25 percent down, the balance is semi-annual serial notes with interest at 6 percent payable over a three-year period.

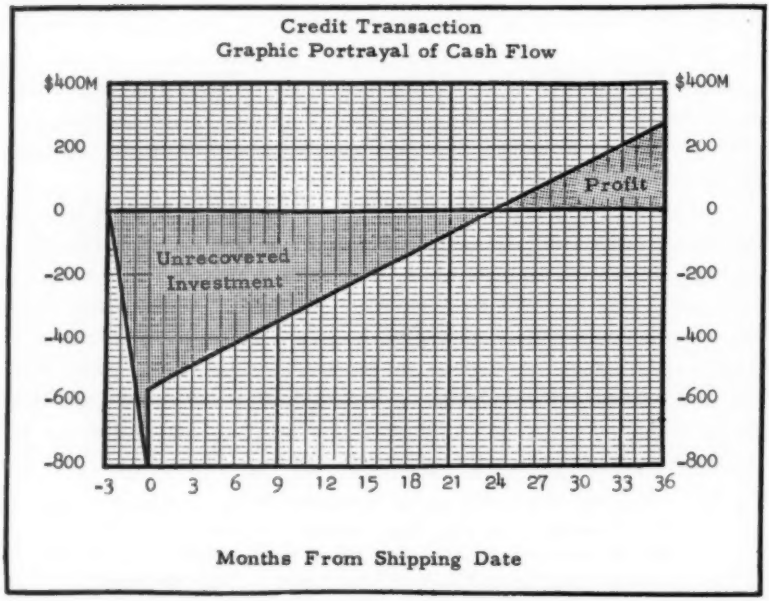

EXHIBIT 1

Graphically, the flow of cash in this transaction is as depicted in Exhibit 1. From this flow, several things should be observed. First, collections for the first 25 months represent return of the investment. The payout period, pertinent to risk evaluation, is approximately two years on the three-year notes. Second, profit is finally realized only after the investment is returned. Discounted to its present value, that profit obviously is diluted relative to a cash transaction involving collection within, say, a thirty-day period. By evaluating the discounted profit as a rate of return and comparing it to a target rate, we can see clearly the financial desirability of entering or not entering into the deal. Moreover, by projecting the discounting of notes at various time intervals or varying

other elements of the transaction, we can see clearly the effect of alternate courses of action.

In tabular form, the data comprising the cash flow is as shown on Exhibit 2. To evaluate the "worth" of this situation, the essential fact to be determined is the rate at which the $800,000 investment would return the cash inflows indicated. Effectively, this involves discounting the receipts back to the shipping point at the rate at which those discounted receipts will equal the amount invested. This calculation shows a 22-percent return in this case, as demonstrated on Exhibit 3.

Credit Transaction
Timing of Cash Flow

Time Relative to Shipping Date	Investment	Customer's Principal Payment	Customer's Interest Payment	Net Cash Flow
- 3 months	(800)	- - -	- -	(800)
Shipping date	- -	250	- -	250
+ 6 months		125	4	129
+ 12 months		125	7	132
+ 18 months		125	11	136
+ 24 months		125	15	140
+ 30 months		125	19	144
+ 36 months		125	22	147
	(800)	1,000	78	278 (Profit)

EXHIBIT 2

Evaluating Risk

In the foregoing, the return rate has been determined solely on a projected cash flow basis without direct consideration of bad debt risk (although payout period gives some degree of risk evaluation). However, in the form of note discounts quoted by banking sources, we actually have a very real basis for expressing and measuring the impact of the risk element. If the financial market quotes a discount of 9 percent to pick up notes bearing 6 percent interest, the 3 percent premium is the effective risk factor. Applying the risk element to the cash stream and discounting the "adjusted flow," we see that our return rate, including risk evaluation, has been reduced to 20 percent, as shown on Exhibit 4.

DISCOUNTING CASH FLOW TO DETERMINE RATE OF RETURN

Time Relative to Shipping Date	Cash Flow	22% RATE Discount Factor	22% RATE Value at Shipping Date
- 3 months	(800)	1.0280	(822)
Shipping Date	250	1.000	250
+ 6 months	129	.8959	116
+ 12 months	132	.8028	106
+ 18 months	136	.7194	98
+ 24 months	140	.6448	90
+ 30 months	144	.5781	83
+ 36 months	147	.5183	76
Total Value of Discounted Receipts			819 *

* Difference from investment is insignificant and due to rounding, etc.

EXHIBIT 3

While departing from the basic premise of dealing purely in cash terms, this technique enables us to develop the impact of risk as evaluated by the market. And it is only after we have measured this risk that we have a realistic point of departure from which alternatives may be gauged.

Basic Alternatives

The 20-percent return from holding the notes to maturity obviously takes on its greatest significance when measured against a straight cash deal or a transaction in which the notes are discounted in the financial market. In a straight cash

Discounting Cash Flow to Determine Rate of Return With Evaluation of Risk Element

Timing	Cash Flow	Value of Risk Element	"Adjusted" Flow	20 % RATE Discount Factor	20 % RATE Value at Shipping Date
- 3 mos.	(800)	- -	(800)	1.0254	(820)
Shipping date	250	- -	250	1.0000	250
+ 6 mos.	129	(2)	127	.9048	115
+ 12 mos.	132	(4)	128	.8187	105
+ 18 mos.	136	(5)	131	.7408	97
+ 24 mos.	140	(6)	134	.6703	90
+ 30 mos.	144	(7)	137	.6065	83
+ 36 mos.	147	(9)	138	.5488	76
	278	(33)	245		816

EXHIBIT 4

transaction involving 25 percent down and the balance on 30-day open account, we would see this flow:

Timing	*Investment*	*Customer payment*	*Net cash flow*
— 3 mos.	(800)	—	(800)
Shipping date	—	250	250
+ 1 mo.	—	750	750
	(800)	1,000	200

Here we see a profit of $200,000 realized one month from the shipping date and four months from the start of the project; when handled via notes we took a profit of $278,000 ($245,000 after risk evaluation) not fully realized until 36 months after shipping date. This timing impact is tremendous: where we had a risk-evaluated return of 20 percent on the note arrangement, the cash transaction produces a return rate of 120 percent.

The second alternative, that of discounting the notes, would result, assuming a 9-percent discount rate and notes sold 60 days after shipment, in a return of 75 percent.

In summary, then, the three basic routes that we might take would yield returns as follows:

Cash transaction	120%
Notes discounted after 60 days	75%
Notes held to maturity	20%

These returns, derived from discounting the cash flow, are the annual rates at which our investment will yield the profits shown for the particular time-periods involved. Specifically the patterns that develop the rates are as follows:

	Initial investment	*Total profit*	*Pay-back period*	*Annual rate of return*
Cash transaction	800	200	1 month	120%
Notes discounted	800	167	2 months	75%
Notes held to maturity	800	245	25 months	20%

It can be seen quickly that these changes in return rate are functions of profit rate, capital turnover and discounting of future dollars to present value. In the relatively short time-periods that we have incurred in these examples, a good "feel" for relative return rates can be determined by reference to the classical formula: capital turnover $\times$ profit as a percentage of sales $=$ return on investment. However, the increased degree of realism provided by discounting becomes important in using a return rate, as will be shown in subsequent paragraphs.

Other Variables

That the basic alternatives shown above take the priority indicated, is not new, of course. However, having measured the extent of impact produced by these alternatives, we have a framework for moving into the area of decision-making. The extent to which management can control the profitability of such transactions is largely centered in a few questions, assuming that the customer would not buy at our price on a straight cash deal:

1. What is the highest bank discount rate we could accept on the notes and still show a higher return than by holding notes to maturity?
2. What credit costs could we afford in order to reduce our investment?
3. What additional investment could we afford to shorten the in-process cycle?

4. What price reduction would we make to induce a cash sale versus an extended credit deal?
5. In a high-risk venture where we might be unable to get the paper discounted, what price premium would be needed to yield us our target rate of return (assuming that the 20 percent is inadequate)?

Maximum Note Discount

Determination of the discount rate cut-off point serves to illustrate the use of basic return rates in evaluating areas of decision. The highest discount rate that we could accept and still show a profit over holding the notes can be derived by determining the cash proceeds we would need to show a return of 20 percent (the rate earned by holding the notes), then calculating back to the highest bank discount rate that would yield an excess over the proceeds:

PROCEEDS REQUIRED FOR 20% RETURN RATE VIA DISCOUNTING NOTES

a. Value of investment at shipping date $800,000 investment (@ 20% return factor 1.0254)	(820)
b. Customer's down payment at shipping date	250
c. Note proceeds needed (at shipping date value)	570
d. 20% return factor — 2 months after shipment	1.0339
e. Cash proceeds required at time of discounting (two months after shipment)	589

Having determined the cash proceeds required, we then can proceed with calculation of the bank discount rate that will net to those proceeds:

BANK DISCOUNT RATE REQUIRED TO YIELD KNOWN PROCEEDS

Principal & interest		*24% Annual rate*	
Notes due	*at maturity*	÷ *Factor*	*Discounted proceeds*
6 months	129	1.12	115
12 months	132	1.24	106
18 months	136	1.36	100
24 months	140	1.48	95
30 months	144	1.60	90
36 months	147	1.72	85
	828		591
Proceeds required:			589

Here we see that we could discount the notes at a rate as high as 24 percent and still obtain sufficient proceeds to protect our return rate. (The calculation above has been simplified in that commissions or any other bank charges in excess of discount rate have been ignored.)

By similar types of calculation, working from the basic alternatives, we can determine the extent of price variations or other means that might be used to protect our return position.

Summary

The basic evaluation of any financial transaction is in terms of rate of return on investment. Where a sale involves the potential of extended credit terms, it is particularly important that alternative returns be known in order that the most profitable course possible be taken and such alternatives must be measured in a manner which reflects the impact of the three basic return-determinants: profit ratio, capital turnover, and time-value of money.

In measuring a long-term credit transaction, the investment that is pertinent is the cash tied up in the project during the in-process cycle. Cash returns in the form of principal and interest payments, properly time-valued, must then be weighed against the investment. The discounted-cash-flow method provides a relatively simple means for gauging the factors involved and when used for evaluation of alternate routes—cash transactions, note discounting, etc.—will properly reflect the value of change in any of those factors.

Problems in Divisional Profit Measurement

by GORDON SHILLINGLAW

THE COMPETITIVE ENVIRONMENT exerts continuing pressures on management to find ways of maintaining and increasing profits. Expansion of sales of existing products in the company's present markets is one possible solution; diversification into new products or new areas is another. Movements in either of these directions, and particularly into expansion through diversification, often create congestion in the corporate respiratory system. As top management becomes more and more remote from the problems of manufacturing or marketing individual products in the various segments of the company's markets, the old functional lines of communication and responsibility often become inefficient devices for the delegation of decision-making authority. One prescription for the cure of these ailments is an injection of decentralization in large or small doses, as the patient's condition seems to require.

Decentralization, as the term is used today, refers to the creation of a number of semi-autonomous operating units or "profit centers" within the company, each of which is expected to operate in substantially the same manner as a separate firm dependent on its own profit performance for economic survival. Responsibility for overall planning and operating decisions relating to manufacturing and marketing of one particular product line or within a limited geographical area is typically delegated to a profit-center manager. By this means it is hoped that the profit center's operations can be made more quickly responsive to changes in market conditions.

Effective progress toward this goal requires the formulation of a sound system of divisional profit reporting. Unfortunately, the organizational and accounting aspects of decentralization have often been approached independently rather than jointly. Decentralization typically has been conceived of as an organizational matter with profit reporting being viewed as subsidiary, purely within the realm of accounting and data processing. It is a mistake, and often a serious one, to approach these two facets of the problem separately. The controller of one company, for example, recently observed that the first decentralization plan his company had tried had failed because the number of transactions between company divisions had proved so great that the divisional profit reports

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provided information that was too unreliable for managerial use. Advance recognition of the problems of accounting for internal profits, in this company as in many others, could have pointed up organizational weaknesses before they became evident through the malfunctioning of the system. The purpose of this article is to discuss some of these accounting problems and to offer some suggestions for their solution.

Objectives of Profit Reporting

No responsible accountant would recommend that accounting convenience be the controlling factor in organization planning, but the accounting and information-providing problems accompanying any proposed organizational structure should be given serious consideration. Quite often the difficulties that arise in profit decentralization stem from the fact that a single set of profit reports is asked to do too many things simultaneously and with inappropriate foundation. At least four separate but interrelated objectives of internal profit reporting might be recognized:

1. To increase division management's awareness of the company's profit objectives.
2. To give top management some indication of the effectiveness of division managers in exercising the authority delegated to them.
3. To guide division managers toward decisions that will increase company profit.
4. To provide an indication of the profitability of the investment in individual divisions, markets or product lines.

Some of the difficulties that plague internal profit reporting systems stem from a failure to recognize that not all of these objectives can be served with equal effectiveness by routine periodic accounting reports. Specifically, reporting systems frequently place too much emphasis on the fourth objective, the least likely of the four to be achieved.

What are the reasons for this? Management certainly needs some means of finding out whether past investments in a particular division have been adequately profitable. Management also would like to know which segments of the business are producing the greatest results relative to the amount of resources dedicated to them. Profitability data of this sort, however, are of limited usefulness. Managerial decisions relating to the future of any particular division or product line cannot be based solely on a review of past performance. A division with a poor historical profit showing should not be disposed of unless the study of its future prospects indicates that abandonment would increase overall cor-

poration profitability. Historical statements of profitability can do no more than indicate relative strengths and weaknesses of the various divisions. They may indicate that something should be done to improve profitability, but not what. For this purpose we must depart from the routine periodic profit report and study the probable results of various possible courses of action.

Recognition of the fact that routine internal profit measurement is primarily and necessarily directed toward guiding profit-center managers in decision-making, with reported profit serving as a partial indicator of managerial performance rather than investment performance, can ease the way toward a more effective system of profit reporting. The question then becomes one of deciding what profit measurements will best measure this aspect of managerial performance and, at the same time, will lead profit-center managers to make decisions that will increase company profits as well as divisional profits. Before examining this question, however, it will be well to look first at the problem of selecting relevant standards for the evaluation of managerial profit performance. Once a basis has been chosen for deriving profit standards, the measurement problem becomes one of adapting the measure to the standard, a task that is simpler than fitting standards to previously selected measures.

Requirements of Divisional Profit Standards

The use of divisional profit measures presupposes the existence of profit standards. Performance standards of any kind are difficult to establish, even under ideal conditions when operating methods and conditions are standardized and the same operation is repeated over and over again. The conditions under which profit standards must be set are far from ideal, but an effort should be made to achieve standards that meet two major requirements: (1) current attainability by competent division managers and (2) consistency with the degree of divisional profit controllability. It is not necessary that they be uniform for all divisions within the company, except insofar as uniformity means a uniform observation of the two basic requirements for all divisions. Neither is it necessary that they be based on past performance within the company or contemporary performance in other companies. Their essential desired characteristic is that they provide a basis for evaluating how well management has utilized the resources at its command in the environment in which it must operate.

The first requirement, attainability by competent division management, is difficult to define in unambiguous terms. Each division is to a certain extent unique with respect to the conditions that affect its performance. Profit differences can be created by variations in the age or condition of production facilities,

by differences in local wage structures, transportation costs, and raw materials prices, by differences in the types of products handled or customers served, or by differences in the degree of competition faced in the market place. To judge the manager of a pharmaceuticals division by the same profit standard that is applied to the performance of the manager of a fertilizer division is to run completely counter to the concept of standards as measures of reasonably attainable performance. Furthermore, the standard that is applicable in one year may be entirely inappropriate in another if market or operating conditions have changed significantly. Nothing can undermine a profit measurement system more quickly than a standard that is not in tune with current operating realities. It may serve adequately as a target or long-range objective, but it is not a standard of satisfactory managerial performance.

The second criterion, the need for consistency with the extent of divisional profit controllability, applies with equal force to the standard and to the measure of divisional profit. Both should be defined so as to exclude any variances that are not to some significant extent within the control of the division managers. This criterion must be interpreted liberally, of course. Nothing is ever completely and absolutely controllable; controllability always means the ability to influence an item of cost or revenue within limits that may be either very broad or extremely narrow. No measure of profit, no matter how carefully defined, can eliminate the need for judgment in evaluating a manager's effectiveness in profit control. The danger lies in trying to avoid the problem by adopting a profit definition that eliminates so many of the possible sources of variances that the manager is relieved of most of his profit-control responsibilities.

For example, variations in divisional sales are an important aspect of managerial performance even though they may result in large part from changes in general business conditions. To define controllability so narrowly as to exclude this latter kind of variation would be to reduce profit comparisons to a narrow band of cost variances. Changes in the business environment can and should be considered in *evaluating* profit deviations, but not in *computing* those deviations. The difference is significant. There is little that the division manager can do to influence such items as local property assessments, but he *is* expected to react to market changes so as to take advantage of favorable opportunities or reduce the impact of unfavorable developments.

Profit Budgets versus Return-on-Investment Standards

Most companies that have moved far enough in the direction of decentralization to prepare divisional profit reports express divisional profits as percentages

of divisional investment. These return-on-investment ratios are then compared with similar ratios for prior periods or other divisions or with some desired company-wide return-on-investment ratio. Comparisons of these kinds are useful in examining overall profit trends and in identifying weak spots or areas of strength, but their usefulness for managerial performance evaluation is more restricted.

The most serious defect of uniform company-wide return-on-investment standards for this purpose is they they violate the criterion of attainability. The manager of a division operating in a depressed market, for example, is likely to regard uniform company-wide return-on-investment standards as unattainable and therefore unfair. The manager of a division in an expanding market, on the other hand, can often meet one of these uniform standards with relative ease.

Uniform return-on-investment standards are inappropriate for managerial evaluation for still another reason. They do not reflect adequately the degree of divisional profit controllability. The true return on the investment required by any division is indeterminate because many assets and costs necessary to support the operations of a division are administered centrally rather than by the division managers. Allocation of these items to individual divisions is inescapably arbitrary; they are neither controllable by the division managers nor objectively traceable to the operations of particular divisions. As a result, the return-on-investment ratios are not truly comparable with targets drawn from reported performance of other companies or from estimates of the company's own cost of capital. Failure of one division to achieve the target return on investment may merely mean that the division has been assigned too large a share of common costs or common investments. The continuing emphasis on these ratios leads to time-consuming and fruitless efforts to allocate centrally administered investments, despite the fact that the periodic performance report is not intended to be and, in fact, cannot be a faithful indicator of the profitability of investment in the division.

All of this leads to the conclusion that *budgeted profit* provides a better profit standard for managerial performance evaluation than any uniform ratio applied "across the board." This is implicitly recognized by many companies that express their standards in terms of ratios but vary the ratio from division to division. A carefully conceived profit budget is, by definition, attainable with good management under expected operating conditions. The budget may be as high or as low as these conditions seem to warrant. Detailed profit budgets, moreover, provide a basis not only for determining net variations from budgeted performance but also for analyzing the elements that together account for the net variation. Step-by-step breakdown of the return-on-investment ratio into

component ratios, such as margin on sales and asset turnover, though useful, is not nearly so informative as item-by-item analysis of cost and sales deviations from budget.

The use of desired profit ratios for profit standards stems from a confusion of long-run desirability with short-run attainability, or a confusion of managerial evaluation with activity evaluation. As we have already indicated, these are not identical. Merely because management desires a certain return on investment does not make this a valid standard for use in evaluating current managerial performance, although it may have some relevance in examining the profitability of the activities that make up the division.

The use of budgeted profit rather than return-on-investment standards permits the elimination from the division manager's performance report of profit deviation due to noncontrollable elements. This can be done in several ways. First, profit and therefore the profit standard can be defined as controllable profit, thus eliminating the noncontrollable items altogether. If other factors make it seem desirable to include noncontrollable items on the profit report, however, two other routes are open. One way is to adjust the profit budget after-the-fact to eliminate any deviations in these items. For example, if allocations of central office costs exceed the initial budget allowance, the allowance may be increased to offset the difference. The other and generally preferable method is to design the accounting procedures by which noncontrollable items get into the profit reports so as to eliminate any deviations before they are reported. For example, each profit center can be charged for specifically identifiable services rendered to the division, priced at a fixed rate per unit of service. The costs of non-identifiable services and general administrative overheads can be charged to the profit center as a lump sum, determined in advance, equal to the amounts included in the profit standard and unchanged from month to month. In this case the administrative cost variance, or difference between the predetermined lump sums and actual administrative and service department costs, is treated as a corporate expense, not allocated to the divisions.

A fourth possibility is to allow the deviations to appear but to segregate them in a "noncontrollable" section at the bottom of the profit report, but this carries with it the danger that the line will not be observed and that deviations in these items will creep into the evaluation process.

The desirability of adjusting the cost recording procedures rather than the profit standards is most apparent in the case of service-center costs that are charged to profit-center managers. If the quantity of service consumed is controllable by the profit-center manager, the use of predetermined rates per unit of service eliminates the price effect from these charges and restricts deviations

to those stemming from the quantity or mix of services consumed. If these services are priced at average historical cost, the task of separating the price effect from the quantity effect may be extremely difficult, particularly if the service in question is not one that can be measured in single homogeneous units such as pounds or man-hours.

Controlling Divisional Investment

Advocates of the return-on-investment approach to divisional profit reporting and evaluation rely heavily on the argument that the use of divisional profit budgets, established without reference to the amount of invested capital, reduces the accountability of the division manager for the prudent use of capital funds. Clearly, some mechanism must be provided to regulate internal capital investment. Capital is invested to produce profits. If profit expectations are inadequate, investments should not be made. But the periodic divisional profit report is not the appropriate weapon to achieve this objective.

Turning first to that portion of the company's capital funds that can be identified specifically with individual divisions, it must be recognized that most of this investment is not currently controllable by the division managers. Changes in the stock of plant and equipment occur only gradually, and in any one month or year the division manager works with facilities that are substantially unchanged. For these it does not much matter whether profit is expressed as a ratio to investment. Second, as far as the current capital budget is concerned, major decisions are made or reviewed by top management and the justification of these proposals depends more on expectations related to the *future,* over a period of time, than on this year's reported return on investment. Control over the division manager's exercise of his limited authority in these projects is best accomplished by incorporating provisions for planned cost reductions and profit improvement in the operating profit budget. This should be accompanied by procedures that will require division managers to justify new capital expenditures on the basis of anticipated profitability and to limit severely expenditures on projects that cannot meet such tests.

There is, however, one portion of divisional investment which is often subject to a substantial degree of current control at the division-manager level and this is the investment in working capital, particularly investments in inventories and sometimes receivables. The division manager can influence receivables by selecting his customers, by altering his terms of sale, and by regulating his efforts to collect overdue accounts. He can influence inventory levels by changing re-order levels and by adjusting production schedules.

One way in which the importance of investment control over these elements can be brought home to the division manager is to include a provision for interest on controllable investment in the division's profit budget and to charge interest to divisions on the basis of actual controllable investment balances. This practice ties in very nicely, for example, with the inventory-control formulas used by many companies to achieve a balance between the costs of carrying inventories and the economies of long production runs and stable production levels. Interest charges on a division's controllable investment, however, should be restricted solely to the managerial performance reports. If return-on-total-investment ratios are calculated for comparison with desired or long-range target ratios, deduction of interest charges in computing net divisional income would result in double counting.

Transfer Pricing and Organization Structure

Thus far we have said little, except indirectly, about the ways in which advance recognition of accounting problems can influence organization structure. It goes without saying that the smaller the profit center relative to the size of the corporation the greater the allocation problem. This problem can be solved, however, along the lines suggested earlier. The problem of transfer pricing, on the other hand, is not so easily dismissed. The transfer price, that is, the price paid by one profit center to another for products transferred between them, can have an important bearing on the profits reported by each. The greater the number of transfers, the greater will be the problems of measuring and evaluating divisional profits. To facilitate discussion, definitions of a few terms will be helpful. The item to be transferred from division to division is called the *intermediate product*. The division in which this item originates is the *supplying division:* the division to which it is transferred is the *buying division*.

The most difficult aspect of the transfer pricing problem is that the transfer price must consider two distinct objectives, objectives that are often in conflict. First, the transfer pricing system should assist management in securing an economic allocation of resources, that is, it should facilitate decisions as to make or buy, sell or process further. Second, it should permit measures of divisional profit performance that will be regarded as reasonable by the various division managers. Solving both of these problems simultaneously is a difficult task.

The most commonly used or proposed methods of transfer pricing fall roughly into five groups:

1. Full cost.
2. Marginal cost or variable cost.

3. Market price.
4. Negotiated price.
5. Marginal or variable cost plus fixed cost subsidy.

Whether cost-based systems rest on standard cost or on actual cost, the basic method is the same. Space is inadequate to cover all of these methods, but a quick look at two or three of them may serve to indicate at least the kinds of problems to be encountered.

Suppose a division manager is faced with the problem of choosing between an outside vendor and an internal supplying division for all or part of his requirements for a certain intermediate product. If he is given free choice as to his sources of supply and if his financial performance is to be judged on the basis of divisional reported profit, then he will very likely choose the source with the lower price, other things such as reliability and quality being equal. But suppose now that the transfer price is based on full normal cost plus a mark-up, that the supplying division is operating at 60 percent of normal capacity and that the outside price is less than this full cost but greater than internal incremental costs. Company profit will be higher if the intermediate product is purchased internally, but the reported profit of the buying division will be lower. Here is the dilemma. If strictly applied the principle of decentralization requires that the buying division manager be granted control over his sources of supply. If there is complete rigidity in the transfer price, the only way that top management can prevent an action that would reduce company profit is to abrogate the buying division manager's authority and order him to purchase internally. But, in these circumstances, how can the buying division manager be held responsible for his division's reported profit?

Many economists have suggested that the proper solution is to set transfer prices equal to the marginal or incremental cost of manufacturing the intermediate product. This will solve the resource allocation problem, but it raises some serious problems of profit measurement. When the supplying division is operating at less than full capacity, defined in some reasonable way, internal transfers of the intermediate product at marginal cost or, to be more realistic, at average variable cost, assuming constant average variable costs, should neither increase nor decrease his reported profit. But as the supplying division approaches capacity operations, the transfer of additional product internally requires the diversion of product from external customers, presumably willing to pay more than marginal cost. Forced transfers at marginal cost, therefore, violate the principle of delegation of authority and may also reduce overall company profit by diverting product into less profitable uses.

It is this weakness of marginal cost transfer pricing, compounded by the difficulty of obtaining reasonable approximations to marginal cost schedules, that has led a number of writers and a considerable number of companies to adopt one of the other three methods on the list. Space remains for only a brief mention of one of these, interdivisional negotiation of the transfer price. When idle capacity exists, the supplying division will be willing to reduce the transfer price as long as it is still high enough to cover incremental cost. When demand for the intermediate product is strong, however, the buying division must be willing to pay a price that reflects the supplying divisions's outside opportunities.

To make a system of negotiation work satisfactorily, two conditions must be met. First, both the supplying and the selling divisions must have authority to go outside to sell or buy the intermediate product if they are dissatisfied with the transfer price. Otherwise we have a situation that the economists call bilateral monopoly, in which the bargaining range is very wide and the transfer price will indicate nothing more than who is the more forceful bargainer. Second, there must be realistic outside opportunities for both buyer and supplier. Ideally, there should be a fully competitive independent market for the intermediate product, but as a minimum, the supplying division must have a ready means of marketing its capacity to outside purchasers, and the buying division must have access to alternative sources of supply. Freedom to sell outside is meaningless if the supplying division has no ready independent outlet for its capacity; freedom to buy outside is an illusion if the company refuses to disclose product specifications to potential outside suppliers.

It is the lack of satisfactory intermediate markets, more than any other single factor, that makes it extremely difficult to decentralize effectively on a functional basis. Many transfer pricing problems would disappear if the division structure could be reorganized around product lines or geographical regions. Transfers within each division could then be made at full standard cost or incremental cost because the functional subexecutives in each division cannot be expected to make final decisions on make or buy, or sell or process further. Such decisions would be the province of the division manager and his staff, who could look at the problem without worrying about the realism of the transfer prices within the division. It is easy to forget that profit decentralization is not a substitute for the other control techniques of budgeting and standard costing, but an extension of them. Within each decentralized division or profit center, just as in the completely centralized firm, functional performance continues to be measured in these more traditional terms.

Negotiation is not without its pitfalls, and it would be rash indeed to recommend this solution in all cases. Competitive alternatives simply may not exist,

or the costs of contacting independent outside markets may be prohibitive. Under these circumstances there are no really effective checks on negotiation, and some other method generally must be adopted. Such situations often can be recognized in advance, however, and a decision to draw organizational lines in such a way that internal transfers of noncompetitive intermediate products will be substantial should be made in full recognition of the profit-measurement problems this will create. As we said at the outset, accounting convenience is not a governing factor in organization planning, but it is relevant. The solution may be, when noncompetitive transfers are inevitable, to budget separately for internal and external sales and to compute budget deviations separately for each. This kind of flexibility, of course, is available only if profit standards are based on profit budgets rather than on uniform return-on-investment ratios.

Conclusions

The problems of internal profit measurement are many and varied, and we have yet to reach the position at which we can say that they are entirely solved. We can, however, indicate some of the directions in which these solutions can be found. First, it should be recognized that the major purpose of divisional profit measurement is to provide information for evaluation and control of managerial performance rather than for appraising the profitability of the division's facilities or product lines. Second, the divisional boundaries should be established in such a way as to reduce the number of interdivisional transfers and to permit effective market checks on the realism of transfer prices. Third, the measure of divisional profit should be based on the principle of controllability, either eliminating noncontrollable charges entirely or making them in such a way as to lead to no variances from profit standards. And finally, the profit standard for managerial evaluation should be based on budgeted data, specifically attuned to the current operating potentialities of each division, independent of long-run normal desired yields on invested capital. It is on this last point that the greatest difference of opinion will exist but, if we accept the premise that what we are trying to do is to provide a measure of managerial performance, no other conclusion is warranted.

Leasing Equipment—Advantageous to Whom?

by WALTER C. BAUER*

AMONG the many articles written in the past dealing with the economic pros and cons of leasing equipment, Frank S. Lyndall's "Leasing Equipment—What Are The Advantages" in the August, 1960, issue of the *Bulletin* easily ranks as one of the more searching and objective. It explodes some of the imaginary advantages customarily extolled by interested or uninformed proponents, but admits that leasing may be warranted in some instances.

Perhaps foremost in importance is the obvious advantage of leasing equipment used for defense and other government contracts. This is so because contractors are not allowed to include any return on the use of equipment *owned* by them, but are permitted to claim the full rental cost, although the latter includes, of course, an interest cost element. The additional advantage of leasing is that rental costs of special purpose equipment are more readily substantiated than depreciation charges, repair costs, etc., for purchased equipment, especially when the contract term is short or if the contract is prematurely cancelled. The U. S. Treasury probably could save money if it encouraged the use of purchased equipment by allowing a moderate return on such investments. The financing costs for leased equipment frequently amount to 8, 10, 12 percent or even more per annum.

More questionable is Mr. Lyndall's assertion that the use of leased automobiles, office space or storage facilities may prevent a state from assessing either income or franchise taxes as long as a company restricts its activities in that particular state to selling. In the light of the Stockham Valve and Northwestern States Cement cases decided by the U. S. Supreme Court in early 1959, it appears unlikely that state income taxes could be avoided merely because the company leased rather than owned these facilities.

It is true, however, that the "financing" of equipment through long-term-leases may reduce the tax load in some states. For instance, the present Texas franchise tax law excludes such commitments from the taxable capital basis, since they are not recorded in the company's balance sheet. On the other hand, financing in whatever form to purchase the same equipment would increase the capital basis and thus result in a higher tax. This is an unusual situation, though, since the tax laws of many states require that rental payments be capitalized through appro-

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priate multipliers to arrive at the so-called property factor.

In these troubled times, it may be appropriate to consider the possible impact of the various financing methods in the event that excess profits tax laws should be reactivated in some form or another during a future emergency. Leasing commitments apparently did not qualify as "average borrowed capital" in the past and may not do so in the future. Needless to say, this is strictly a conjecture—and a matter which we all hope never to be confronted with again.

Mr. Lyndall further asserts that managers of supposedly well-managed companies favor the leasing of certain equipment to avoid the red tape of cumbersome appropriation requests procedures and the resulting delivery delays. It sounds rather obvious that such an approach—while perhaps "practical" under the circumstances—indicates a looseness in operating procedures. Certainly if proper authority and evidence of sufficient pay-out and yield are required for the *purchase* of a piece of equipment costing $10,000, then similar authority would seem mandatory for the incurrence of a contract committing the company to 60 monthly rental payments of perhaps $210 each. This is particularly true if the lease is noncancellable, either outright or through a hard-to-meet purchase clause.

Mr. Lyndall's comments about an unsuspected but not less important reason why leasing becomes increasingly more popular will not be appreciated in some quarters. He refers to those executive bonus plans which base compensation on a percentage of profits after deduction of a specified return on investment. Higher bonus payments naturally result under this arrangement unless the capital base of the leased facilities is properly taken into consideration.

Return on investment comparisons between plants, divisions or companies call for similar adjustments if leased facilities are used to a material extent. This will avoid possibly large distortions brought about by the choice of different financing methods—ownership of facilities by one group of operations while another group might use leased facilities to a substantial degree.

In the final analysis the most meaningful test of profitability is based on common stockholders' equity. This ratio is influenced to varying degrees by the operating efficiency and capital structure of the various units. The choice of the most economical financing method for the use of equipment and working capital should not be overlooked, however. In this connection, the August 1, 1960 issue of *Forbes* magazine made the interesting observation that Food Fair Stores ranked first among the six largest food chains both on the return per sales dollar and on the return on equity basis. Food Fair Stores significantly endeavor to buy or control as many

stores as possible and lease only slightly over half of their stores. This is in marked contrast to the policy of most chains, which rely on leased locations almost exclusively. The president of Food Fair Stores maintains that ownership cuts normal rental cost by 10 to 15%, a substantial saving in the highly competitive and low-profit food retailing business.

In the face of the popular clamor about the advantages of leasing over buying, it is fair to ask: advantageous to whom? Close analysis in many instances will indicate that the additional working capital provided by taking the lease route is quite expensive in comparison with alternate financing possibilities. Furthermore, the lessee gives up potentially valuable ownership rights since the equipment in question presumably retains some usefulness at the end of the lease period. The lessor's estimate of the prospective life expectancy obviously tends to be conservative unless the lease agreement is noncancellable. Not to be overlooked are incidental costs in the form of legal fees, stringent insurance requirements, trustee's charges, etc., which may run substantially higher than those required under alternative financing methods.

Summing up, leasing of equipment and real estate is not a financing panacea as purported by some of its more enthusiastic advocates. Each alternative between ownership and lease must be considered on its own merits.

Accounting for Fixed Assets — A Case Study

by GENEVA G. HARPER

IT IS BECOMING increasingly more important that a company, while maintaining accurate detailed records of assets and depreciation reserves in an orderly manner, keep the clerical work of maintaining such records at a minimum level. Following is a case study of the fixed asset procedures in use by our company, which is engaged in the manufacture of heavy construction equipment.

Capitalization; Distinguishing from Expense Purchases and Repairs

In order not to burden the property records with many small items, it is desirable to establish a minimum dollar amount for each classification that will be capitalized. Except for land, automobiles and trucks, which are wholly capitalized, all expenditures below the minimums stated below are charged to expense, as are expenditures for items with an expected useful life of less than one year, regardless of the amount:

1. Buildings and improvements—$300.
2. Manufacturing machinery and tools—$300 except as follows:
   a. Electric motors of one horse-power or more are capitalized regardless of purchase price.
   b. The following tools, because of a short useful life, are charged to an expense account, even if the cost is more than $300: grinding wheels, hobs, die chasers (not die heads), drills, gear cutters and replacement teeth for milling machines.
3. Office furniture and fixtures—$75.

Often it is difficult to distinguish between expenditures for property which should be capitalized and major repairs which should be charged against current operating expenses. However, most border-line cases can be resolved by applying the following differentiation:

1. *Capital*
   —A substitution for an item previously capitalized.
   —Prolongs appreciably the life of the property.
   —Increases the value of the property.
   —Makes the property adaptable to a different use.

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2. *Repairs (expensed)*
   —Restores to a sound state or mends.
   —Keeps the property in an ordinarily efficient operating condition.
   —Does not add to the value of the property.
   —Does not appreciably prolong the life of the property.
   —Keeps the property in an operating condition over its probable useful life for the uses for which it was acquired.

Capital Authorization Approval

In order to control expenditures, an Authorization for Expenditure (Exhibit 1), subsequently referred to as an A.F.E., must be prepared and approved for each capital expenditure, regardless of the amount, before a purchase order can be placed or construction started. The form is prepared in quadruplicate by the department manager, submitted to the division manager and, if approved, sent to the plant controller. The plant controller determines whether or not it is a capital expenditure and assigns a number to the A.F.E. The A.F.E. is first entered in the register of capital projects, with the information on date originated, description and amount, and then routed according to the following:

Description	*Required Approval*
Projects up to $2,000	Division manager
Projects $2,000 to $5,000	President
Projects $5,000 and up	President and management committee
Purchases of real estate and leases of more than twelve months	President and management committee

When the approvals have been obtained, the plant controller assigns, if necessary, a job number, accumulates installation costs and indicates the final accounting distribution. After the date of final approval and job number is recorded in the A.F.E. register, all four copies are returned to the originator, who then attaches the purchase requisition, if there is a purchased item, to the original and sends it to the purchasing department. The second copy is sent to the property accountant, the third copy to the cost department and the fourth copy retained by the originator.

In the event that the cost of the project exceeds the original estimated cost by as much as 10 percent, and is $100 or more, a supplemental authorization must be prepared and routed through the same channels as the original A.F.E. for approval, with an explanation for the overage.

A report is prepared each month for the management committee, listing each

of the projects by A.F.E. number, description, amount approved, charges as of the preceding month, charges made during the current month, total charges to date, and the balance over and under the amounts authorized.

AUTHORIZATION FOR EXPENDITURE

Plant _____

Approval and Routing:	Approved	Date
Department Manager, _____		
Division Manager, _____		
Plant Controller, Cap. ( ) Exp. ( ) _____		
President (Over $2,000) _____		
Mgmt. Committee (Over $5,000) _____		
Plant Controller for Distribution _____		

Authorization No. _____
Date _____
Job No. _____

1. Check primary purpose of expenditure.
   - ( ) Replacement of existing facility
   - ( ) Cost Reduction
   - ( ) Increased Production
   - ( ) Other - _____

2. Description of item or project _____

3. Requested by _____ Division _____ Department _____

4. Is this a replacement? _____ Book value of item to be replaced or repaired. $ _____

5. What will be scrapped or traded in? _____ Trade in Allowance $ _____

6. Why must the expenditure be made now, and what benefits will be obtained from this project? _____

7. If expenditure is for cost reduction, attach separate schedule showing basis for computation of savings for an annual period.

8. When will project be completed? _____ If purchased item, enter delivery date anticipated. _____

9.

Cost Estimate	Original	Supplement	Total
Labor			
Overhead			
Materials from stock			
Purchased items			
Contractor's bid			
Contingency allowance			
Other Costs			
Total			

10. Suppliers and/or contractors involved. _____

11. Attach any prints, detailed estimates, etc., which would be helpful in analyzing this request. _____

Prepared by _____

EXHIBIT 1

Identification and Location of Assets

At the time of construction or receipt of manufacturing machinery, automobiles and trucks, a factory identification number is assigned by the plant engineering department. This number is either painted or stamped on a metal tag and attached to the item. It is the responsibility of the plant engineering department to notify all departments concerned of the receipt, the identification num-

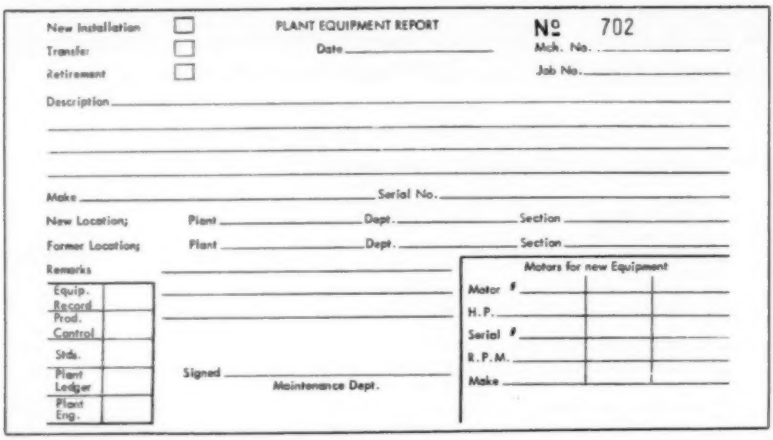
New Installation ☐ PLANT EQUIPMENT REPORT No. 702
Transfer ☐ Date _____ Mch. No. _____
Retirement ☐ Job No. _____
Description _____
Make _____ Serial No. _____
New Location; Plant _____ Dept. _____ Section _____
Former Location; Plant _____ Dept. _____ Section _____
Remarks _____
Equip. Record
Prod. Control
Stds.
Plant Ledger
Plant Eng.
Signed _____ Maintenance Dept.
Motors for new Equipment
Motor # _____
H.P. _____
Serial # _____
R.P.M. _____
Make _____

EXHIBIT 2

ber assignment and the location, by building or department, of the asset. This is done by issuing a Plant Equipment Report (Exhibit 2).

Whenever machines or motors are moved from one location to another, a plant equipment report is issued, showing both the previous and the new location. If only one motor is being moved, a slightly simplified form, called motor transfer is issued.

By means of these two types of transfers, the property accountant makes notations as to the location on the space provided on the back of each ledger sheet. This sheet is then transferred to the ledger section for the department using the machine, thus making it possible to list the machines in a given department at any time.

When office furniture is received, the office management department assigns an identification number and informs the property accountant of the assignment and location of the asset.

Ledgers

Separate ledgers are maintained for each of the fixed asset classifications. The ledger sheets are kept in the following order:

Land. According to date of acquisition

Buildings and improvements. There are several groups of buildings, designated as Plant 1, 2, etc. The ledger sheets are filed as to plant number location. In each plant section there are two groups of facili-

ties: those depreciated on the straight-line basis and those depreciated on the declining-balance basis. Each ledger sheet represents the cost of the building, itself, with the ledger sheets pertaining to improvements to that building immediately following it.

Manufacturing machinery. Ledgers are maintained by department number order. For each department there is a section for straight-line basis facilities and a section for declining-balance basis facilities. Under each of these sections the facilities are recorded in identification number order.

Furniture and fixtures. The office machines are grouped together by the various types, according to the date of acquisition. The furniture, which is numbered when received, is kept in numerical sequence. Here again, we have two classes of facilities, those on the straight-line basis and those on the declining-balance basis.

Automobiles and trucks are segregated into straight-line and declining-balance facilities. The items are filed in numerical order according to the identification number assigned to them at the time of acquisition.

Depreciation Schedules

At the end of each year, an itemized list is made of fixed assets showing original cost, monthly depreciation rate and accumulated reserve to date. These lists substantiate the general ledger balances, and it is from these schedules that our monthly entries for depreciation are made.

Additional ledger sheets are made up for all items capitalized during the preceding month, giving a complete description of the facility, serial numbers, motor numbers, factory numbers assigned, A.F.E. number, purchase order number, and the amount of depreciation by the month (Exhibit 3). These sheets are put in their proper location and entered on the departments' depreciation schedule sheets. Any adjustments to the monthly depreciation provisions are also recorded on the depreciation schedule sheets, as well as entries for any sales or retirements. The sheets are totaled for the current month and a running total is maintained for the reserve for depreciation. This eliminates the necessity of adding detailed entries in the property ledgers each month to verify that the monthly depreciation amount is correct. Another purpose is that the sheets serve as a detailed report of all transactions, new acquisitions, transfers between departments, sales, retirements, and changes in depreciation in any particular department or account. The various departments and fixed asset classifications are recapitulated at the end of each month, showing the cost value, monthly depreciation and accumulated reserve to date for the current month, and it is these schedules that support the entry for depreciation expense for the month.

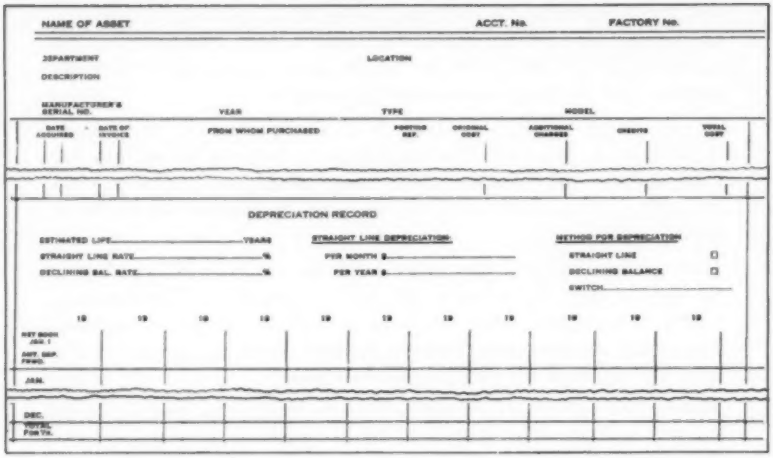

EXHIBIT 3

Sales and Retirements

Whenever an item is sold or scrapped, a plant equipment report (Exhibit 2) is issued, advising the date, description of the item and disposition made of it. The accounting department uses this report as the authorization for writing off items that have been scrapped, and charging the account for gain or loss on the sales of fixed assets, for those items that have been sold.

Summary

Through cooperation between the accounting, office management, and plant engineering departments, the property ledgers become an up-to-date reference and an accurate record of the fixed assets of the company. This paper thus illustrates a case where accountability for fixed assets is recognized through:

1. Classification of expenditures.
2. Control of appropriations.
3. Recording proper identifications and locations.
4. Adequate ledgers.
5. Recording dispositions.

To know what the company owns and where it is, certainly "fixes" those responsibilities where they squarely belong—to the accounting department.

Is Your Accounting System Productive?

by HARRY N. KAMPH

MANAGEMENT decision-making is concerned with all facets of both current operations and forward-planning. The accounting system, in order to be productive, must provide necessary guideposts at every step of executive action.

Aggressive actions[1] are of an expanding or enlarging nature. Such actions embrace new capital acquisitions and space or facility expansion, expansion into new markets and production of new products, decisions on new research and development projects and decisions on new engineering programs, programmed increases in labor force and increases in various kinds of overheads.

Contractive actions are of a condensing or reducing nature. These actions embrace permanent or temporary shutdown of equipment, permanent or temporary reduction in operating space or facilities, or actual disposal of equipment or facilities without their replacement, abandonment of unprofitable markets or products, programmed reductions in labor force and related overheads. Contractive actions by their nature are usually more difficult to achieve and often require greater insight and will power on the part of management, than aggressive actions.

There may be combinations of aggressive and contractive actions (all for the end-purpose of increasing profits) including such projects as:

1. Process or model contractions to reduce costs, to improve acceptance of product, or both.
2. Procurement or facility consolidations designed to reduce operating costs and market prices.

Basic Features of the Productive Accounting System

A *productive* accounting system is capable of producing:

1. Timely results or reports—economically.
2. Data necessary to all management decision-making, whether it be for aggressive action, contractive action, or a combination of both.

[1] An excellent guide to aggressive action decisions in relation to capital acquisitions is the N.A.A. Research Report No. 35, *"Return on Capital as a Guide to Managerial Decisions,"* December 1, 1959.

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To improve or to ensure the productivity of the accounting system, it is first necessary to review the adequacy of its basic features:

A chart of general ledger accounts, which completely divulges or classifies all the necessary data for aggressive or contractive actions related to any element or function of the business, no matter what or where it may be.

A network of operating documents to record all actions however remote, related to men, materials, machines and finished products—accurately, completely, economically, and on a timely schedule.

A system of journals and ledgers for classifying and summarizing the data recorded on operating documents—utilizing the technique adequate for the particular business entity. (Today's range, from improved manual methods through peripheral machines, to the ultimate in electronic data-processing hardware, present both opportunity and challenge to the industrial accountant.)

The fundamental reports and control tools, including:

1. Major financial statements.
2. Departmental or functional supporting schedules.
3. Periodic performance reports—for materials, labor, overheads of all kinds, sales volume, product mix, distribution costs, work orders, capital acquisitions, research costs, engineering projects, etc.
4. Specific analytical reports related to areas of particular management scrutiny—including rework, scrap, sales returns, policy allowances to customers, accounts receivable losses, lost-time accident costs, machinery and equipment breakdowns, etc.

An accounting workforce geared to produce documents, records, reports, and auxiliary analyses to predetermined timetables and within budgeted administrative costs.

The Accountant in the System; Productive Management Reports

Although the accounting system may reasonably conform to all of the basics just outlined, its peak value, under the ever-shifting conditions of dynamic business activities, is finally brought about by the intrinsic attitudes and abilities of the industrial accountant responsible for the accounting system's productivity.

What does it take in the way of skills and attitudes to give management what it urgently needs for successful decision-making? Twenty years ago, *technical ability* in the field of accounting might have been considered the sole criterion. Later, the *managerial ability* to get the job done through group effort would definitely have been added as an imperative. Now there is a third dimension, which should be considered in three parts:

1. Insight into the executive's processes of decision-making. The industrial accountant must know the man behind the executive job in order to supply the kind and form of financial material which he can comprehend and act upon decisively.
2. Enterprise—a willingness to delve into and to explain, before any specific executive request is made, all important deviations from normal performance or normal profit.
3. Imagination in the presentation of data to management in order to pinpoint specific areas of profit potential or problems.

Executive decision-making can be sure and dependable only when backed by reports which give concise supporting facts. A series of management reports has been selected to illustrate types of figure displays which have proved effective in guiding the actions of various management teams. They are by no means exhaustive but they may help to demonstrate how insight, enterprise and imagination can be used in best serving the executive team, even with simple well-known reports.

Flash Profit and Loss Statement

Timeliness is obviously one of the most imperative attributes of management reports. Most executives are perfectly willing to waive "absolute" accuracy for a few days' advantage in analyzing operating data, so that important decisions or remedial actions may be instituted quickly. A recently published executive checklist makes the observation that by the time accountants come up with a period's figures, reflected facts have lost their value as guides to operating decisions. For this reason, the "flash" report is gaining growing acceptance. Though lacking the accuracy of the final accounting statement, it can usually be made available a day or two after the close of the period. Such reports, inevitably reflecting some estimates, are usually in rounded figures which in themselves increase the utility of the data.

In our own company, the Flash Profit and Loss Statement, as shown in Exhibit 1, is made available to top executives two working days after the close of the voucher register. The costing of 1400 jobs each month, using standard labor-burden work-center rates (which is the common practice of the printing industry), does not deter this timetable. Straggling receipt of vendor invoices sometimes necessitates estimating expense items represented, if their effect on the operating figures is material.

Our flash profit and loss statement is in comparative form by period for a full year; thus, it provides fast information to cover the period just closed as

EXHIBIT 1

Flash Profit & Loss Statement
Fiscal Year 1960-61

	1st Period		2nd Period		3rd Period		4th Period		5th Period			12th Period	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%		Amount	%
Net Sales	356,450	100.0											
Cost of Sales	228,320	64.1											
Gross Profit	128,130	35.9											
Factory Labor & Burden	110,450												
Factory Costs Absorbed	107,300												
Over/Under Absorbed	3,150	.9											
Shipping Expense	7,820	2.1											
Selling Expense	46,840	13.1											
General & Admin. Expense	25,985	7.3											
Non-Operating (Net)	(405)	(.1)											
Estimated Income (Before Profit-Sharing & Taxes)	44,740	12.6											

EXHIBIT 2

Work Sheet for Flash P. & L. Statement
First Period 1960

J.V. No.	Explanation	Net Sales	Cost of Sales	Factory Labor & Burden	Factory Costs Absorbed	Shipping Expense	Selling Expense	G. & A. Expense	Non-Oper. Income & Expense	Income-Net
1	Cash Receipts	(150)		(15)			(160)	(10)	250	(85)
2	Sales & Inter-Company Serv.	(360,000)		(425)		(2,055)	(5,500)	(1,050)		(369,030)
3	Credit Memos	3,700		120		15				3,835
4	Payrolls & Fringe Costs			80,000		2,700	35,000	14,500		132,200
5	Factory Labor and Burden Applied to Work in Process				(107,300)					(107,300)
*6	Materials Charged to Work in Process									-
7	Cost of Sales & Dept. Chgs.		228,000	3,600		50	3,600	40		235,290
8	Depreciation & Amortization			5,100		100	650	310		6,160
9	Prepaid & Deferred Expenses Applied			150				1,100		1,250
10	Accrued Expenses			9,100		85	2,150	2,260		13,595
11	Accounts Payable & Disbursements		320	14,570		6,425	10,100	8,585	(655)	39,345
12	Charges Transf'd (Intra-Co.)			(1,750)		500	1,000	250		-
-	Miscellaneous J.E.'s									-
		(356,450)	228,320	110,450	(107,300)	7,820	46,840	25,985	(405)	(44,740)

*Affects Balance Sheet Only

well as the advantage of comparison with prior periods. Where the flash information of any prior period was materially altered in the final reports, this is corrected before the latest period presentation is made. The flash report can be submitted simply in worksheet form or, where the distribution is to be made to several executives, particularly if they are at various locations, a translucent master can be updated from period to period and new prints can be distributed following each period close.

The report is prepared from a worksheet, illustrated by Exhibit 2. The prerequisite for this worksheet is a series of recurring journal vouchers with control totals entered even prior to general ledger posting. Only the journal voucher figures which affect the operating accounts are recorded. For example, Journal Voucher No. 6 which covers "Materials Charged to Work in Process," shows no entries, since it affects inventory accounts only and not the operating statement. It will be noted that the flash worksheet form has columns which follow the sequence of the lines on the flash operating statement and that the column footings are the amounts carried forward into the flash statement. The final worksheet column headed "Income-Net" indicates the net operating effect on each journal voucher and thus provides a cross-check in that its total must prove with the estimated income reflected in the flash statement.

It is easy to visualize that, if a worksheet were expanded to include balance sheet accounts and their prior balances were recorded on it, a flash statement of assets and liabilities could be prepared likewise. In our own case, we find this unnecessary for two reasons:

1. The comparative daily report, explained in the next section, provides most of the important balance sheet changes except those in inventories.
2. The detailed financial reports are obtained early enough in the new period to give us the necessary surveillance of inventories and other factors which may affect cash flow.

Comparative Daily Report

Instead of adopting a separate report form for each operating day of the period, we have elected to use a comparative daily report which gives day-by-day and cumulative information for the entire period, as illustrated in Exhibit 3. Each executive concerned with this information has a ring binder and the month's report is updated early each morning for the prior business day's transactions and changes. Again, where interested executives are not located in the same general area or where the distribution of daily information is widespread,

EXHIBIT 3

Comparative Daily Report
Period _____ 19__

Date	Work Day	Sales		Net Billings		Accts. Receivable		Accts. Payable			Cash			
		Day	Period to Date	Day	Period to Date	Gross Remittances	Balance	Additions	Payments	Balance	Receipts	Payrolls Net	Other Disbursements	Balance
Balances							450,000			80,000				150,000
2	1													
3	2													
4	3													
5	4													
25	18													
26	19													
27	20													
30	21													
31	22													
Totals		-	375,000	-	356,450	325,000	481,450	140,000	150,000	70,000	324,750	119,000	174,500	181,250

EXHIBIT 4

Accounts Receivable Analysis
Fiscal Year 1960-61

	Net Billing for Period	A/R Turnover Days	Total A/R	Current	Total Past Due	30 Days	60 Days	90 Days	Over 90 Days	Special Terms	Disputed, Bankrupt, Legal	Credit Balances
1st Period												
Amounts												
Percentages												
No. of Accts.												
12th Period												
Amounts	225,000	58 Days	435,000	215,000	220,000	150,000	50,000	7,000	6,000	3,000	4,500	(500)
Percentages			100.0%	49.4%	50.6%	34.5%	11.5%	1.6%	1.4%	.7%	1.0%	(.1%)
No. of Accts.					822	510	240	27	15	5	25	

a translucent master may be used and updated prints distributed. Two particularly helpful features of this type of report are:

1. Since the working days of the month as well as the calendar dates are recorded, comparisons may be made at any time between the status of each reported element for the current period and its position on the same working day or calendar date for any prior period. The ring binder permits the filing of reports for as many periods as may be desired. We find it effective to watch the relationship of receivables, payables, and cash balances at certain critical points—as on the 11th, 26th and last calendar day of the month after major disbursements have been made. Moreover, we watch comparative sales and net billings, period by period, on successive working days.

2. Since we know the cycle time in converting sales through production to billings and in converting accounts receivable to cash, our comparative daily report gives us a constant, updated guide to cash flow for the next two periods. In using it for this purpose, we make allowances for capital disbursements, loan pay-offs, predicted changes in inventory balances and major tax payments. Thus, an accurate cash flow report for two or three periods ahead is easily obtainable.

Accounts Receivable Analysis

Another of our comparative management reports released in worksheet form to all interested executives is the Accounts Receivable Analysis (Exhibit 4). Usually, the detailed status of each customer's account is of current interest only to the credit manager's staff and to sales personnel who cooperate with the credit department in customer collections and settlement of disputes. Other executives find a perspective view of accounts receivable, as shown in Exhibit 4, sufficiently detailed and informative. Not only does this analysis provide useful information in projecting the cash flow, but also it may pin-point trouble areas. Symptoms of trouble will stimulate responsible executives to review the accounts receivable situation with the credit department in more detail and to recommend supporting action by sales, legal, and other affected units of the company.

Our executives have found most useful this summarized information on aged receivable amounts, percentages to total accounts receivable, and number of past due accounts by age. Accounts receivable turnover days ($435{,}000 \div 225{,}000 \times 30$ days) is an index which is watched from month to month as a delicate barometer of the effectiveness of credit practices and related general economic conditions.

Break-Even Summary

Accountants are very familiar with the highly useful cost-volume-profit charts which reflect fixed and variable costs in relation to sales dollars. However, there is sometimes over-reliance upon the results graphically presented by these charts, without investigating the problems which may be created by product or model mix. Also, to many executives the adage that a picture is worth ten thousand words is not necessarily true. These executives want to see the numbers. In addition, elements of fixed and variable costs cannot adequately be detailed without making the charts too complex. In any case, underlying these charts, there must be summarized dollar and percentage data by product group, as illustrated in the Break-Even Summary (Exhibit 5), in order to satisfy the ultimate purpose of the analyses.

This example is taken from a manufacturing firm which has two major product lines. The Product A line is fabricated largely with in-plant machinery and outside production; thus, the direct labor cost is shown only as 7 percent of the sales dollar. The Product B line, on the other hand, involves a considerable amount of bench finishing and assembly, with the result that direct labor represents 20 percent of the sales dollar. In the exhibit, all the variable costs in manufacturing, receiving and shipping, sales, and general, are listed as percentages for each product group. They are then combined or weighed in relation to the product mix. Historically, the Product A line represents 78 percent of annual volume and the Product B line 22 percent. The various fixed costs for both manufacturing and other departments are listed. Total fixed costs ($71,750) are shown to represent 37.651 percent of sales, or the complement of the weighted variable costs, 62.349 percent. By dividing the total fixed costs ($71,750) by the fixed-cost percentage (37.651%), total net sales at the break-even point ($190,570) is calculated. When this total is separated according to the predicted sales mix, 78 percent to Product A ($148,645) and 22 percent to Product B ($41,925), it is determined that the Product A line develops a profit of $10,192 and the Product B line an exactly corresponding loss.

The break-even summary, among other uses, demonstrates clearly whether or not it will be possible, with the variable and fixed costs detailed, for the company to make a profit on each product line, giving consideration to the achievable volume of sales of the product line. In Exhibit 5, it is quite clear that the Product B line cannot make a profit within a reasonably achievable volume. Since the variable costs for Product B are 82.485 percent, it is apparent that, with every additional dollar of sales, the maximum profit yield is only 17½¢. Thus, it would take an additional $58,000 in sales to break even on

Break-Even Summary - Per Period
Based on Flexible Budget for Year ____

Variable Costs	Product A	Product B	Combined 78% - Product A 22% - Product B
Manufacturing			
Direct Materials	25.590 %	31.600 %	19.960 6.952 26.912 %
Direct Labor	7.000 %	20.000 %	5.460 4.400 9.860 %
Indirect Labor	.980 %	2.720 %	.764 .598 1.362 %
Overtime Premium & Labor Fringes (O.T. Premium - .300%)	1.720 %	5.515 %	1.342 1.213 2.555 %
Other Variable Expense	1.630 %	2.900 %	1.272 .638 1.910 %
Sub-Total	36.920 %	62.735 %	42.599 %
Receiving & Shipping			
Receiving & Shipping Labor	1.600 %	1.600 %	1.600 %
Overtime Premium & Labor Fringes	.350 %	.350 %	.350 %
Packing & Shipping Supplies	.250 %	.250 %	.250 %
Freight & Other Transportation	3.000 %	3.000 %	3.000 %
Sales			
Representatives' Commission	7.000 %	7.000 %	7.000 %
Volume Discounts	4.500 %	4.500 %	4.500 %
Other Allowances	2.000 %	2.000 %	2.000 %
Other			
Accounts Receivable Losses	.500 %	.500 %	.500 %
Cash Discounts & Sundry	.550 %	.550 %	.550 %
Total Variable Costs (%'s of Net Sales)	56.670 %	82.485 %	62.349 %
Fixed Costs			
Direct Manufacturing Expense	8,000	4,500	12,500
Purchasing			2,900
Receiving & Shipping			1,650
General Plant			2,000
Product Development			5,000
Engineering			4,700
Sales Operations			10,000
Sales Promotion			15,000
General & Administrative			18,000
Total (Other than Direct Manufacturing)	46,215	13,035	59,250
Total Fixed Costs	54,215	17,535	71,750
Fixed Costs Equal	43.330 %	17.515 %	37.651 %
Calculated Net Sales to Break Even	148,645	41,925	190,570
Proof:			
Variable Costs at Break Even	84,238	34,582	118,820
Fixed Costs (as above)	54,215	17,535	71,750
Total Costs	138,453	52,117	190,570
Gain (Loss)	10,192	(10,192)	-0-

EXHIBIT 5

Cost Responsibility Statement
Product A

Budget Revised Date:

Period Budget Amount	Period Budget % S.P.	Period Actual Amount	Period Actual % S.P.	Y/A #	Account No.	Description	Year to Date Actual % S.P.	Year to Date Actual Amount	Year to Date Budget % S.P.	Year to Date Budget Amount
850				1	6101	Supervision-A.Brown		9,000		8,500
750				2	6101	" -B.Smith		7,500		7,500
600				3	6101	" -C.Jones		6,000		6,000
500				4	6104	Indirect Sal.-D.Black		5,300		5,000
@				5	6104	O.T.(Straight Time Only)		200		@
				6						
600				7	6118,19,20,21	Salary Fringes&Pensions		5,500		6,000
@				8	6117	O.T.Prem.-Indirect Sal.		100		@
				9						
3,300	@			10		Total Fixed Sal.Exp.	1.87	33,500	1.84	33,000
	.68			11	6104,7,13	Indirect & Maint.Labor		14,200		12,240
	.10			12	6106	Rework Labor		1,400		1,800
	.20			13	6113	Tooling Labor		3,500		3,600
@				14	6115	Work Order Labor		4,500		@
@				15	6116	Work Order Labor Trsfd.		(4,500)		@
	.30			16	6117	O.T.Prem.-Variable Labor		6,200		5,400
	1.42			17	6118,19,20	Variable Labor Fringes		22,900		25,560
				18						
@	2.70			19		Total Variable Lbr.Exp.	2.68	48,200	2.70	48,600
3,300	2.70			20		Total Payroll Expense	4.55	81,800	4.54	81,600
	.42			21	6131	Supplies-Manufacturing		7,400		7,560
	.67			22	6133,40	Supplies&Serv.-Maint.		11,400		12,000
	.33			23	6138	Supplies&O.P.-Tooling		7,200		6,000
	.11			24	6156	Power		2,400		2,000
	.10			25	6183	Shop Spoilage & Scrap		2,300		1,800
				26						
@	1.63			27		Total Other Var. Exp.	1.70	30,700	1.63	29,360
300				28	6186	Rentals - Equipment		3,000		3,000
550				29	6187,91	Taxes & Gen. Insurance		5,800		5,500
950				30	6194	Depreciation-Equipment		9,750		9,500
2,900				31	6198	Proportion Space (44%)		28,800		29,000
				32						
4,700	@			33		Total Other Fixed Exp.	2.63	47,350	2.61	47,000
4,700	1.63			34		Total Non-Payroll Exp.	4.33	78,050	4.24	76,360
				35						
				36	6100	Total Dept. Burden	8.88	159,850	8.78	157,960
	4.33			37	6199	Burden Chgd.to Invent.	4.33	77,940	4.33	77,940
8,000				38		Period Burden	4.55	81,910	4.85	80,020
				39						
				40	4100	Direct Labor	7.33	132,000	7.00	126,000
	7.00			41	4199	Labor Chgd. to Invent.	7.00	126,000	7.00	126,000
				42		Labor Variance	.33	6,000	@	@
				43						
				44	5100,50	Direct Materials & O.P.	25.35	456,220	25.59	460,620
	25.59			45	5199	MaterialsChgd.to Invent.	25.59	460,620	25.59	460,620
				46		Materials Variance	(.24)	(4,400)	@	@
				47						
8,000	16.92			48		Total Dir.&Ind.Mfg.Cost	41.56	748,070	41.37	744,580
				49						
				50		Total Prod. @ Sales(S.P.)	100.00	1,800,000	100.00	1,800,000
				51						
				52		Direct Labor Hours		65,000		63,000
				53		Direct Lbr.Avge.Hr.Rate		2.031		2.000
				54						
				55		Brdn.perBudgeted-D.L.$		1.269		1.254
				56		Brdn.perBudgeted-D.L.Hr.		2.537		2.508
				57						
Period						Period Ending				10 Periods

EXHIBIT 6

Product B. This would require more than a doubling of the total volume if the historical mix between Product A and Product B sales of 78 percent and 22 percent were to be maintained.

Cost Responsibility Statement

Another use of the break-even summary is to provide the basis for budget comparisons on periodic departmental expense reports. This usage is exemplified in the Cost Responsibility Statement depicted in Exhibit 6. The term, cost responsibility statement, was selected for this type of report to bring the departmental foremen into the cost-reduction program. In the last analysis, without the support and direct implementation of the foremen, there is little chance of success in cost reduction. The report reflects the variable and fixed cost elements summarized for Product A in Exhibit 5.

The illustration, as presented in Exhibit 6, is that of a comparative-spread form which, when shingled in a multiple-ring binder or in a slide-fastening device, will reveal for each department the period-by-period operating data as well as cumulative results. For the period, only the budget figures are shown in the example, with variable expenses aggregating 36.92 percent and fixed expenses totaling $8,000, in conformity with the figures in Exhibit 5. In practice, both actual and budget amounts and percentages are displayed. Some of the advantages of this type of report are:

1. The budget for each variable and fixed expense element is clearly displayed. Variable percentages are not hidden through conversion into their respective dollar amounts for the period.
2. Burden elements are segregated into four principal expense groups —fixed salary, variable labor, other variable and other fixed. To avoid undue detail wherever possible, accounts are grouped, as in the case of "Salary Fringes and Pensions" (Account Nos. 6118, 6119, 6120, 6121). Moreover, for fixed salaries, where only a few are involved, specific names can be shown (lines 1 through 4), in order that close and constant scrutiny may be directed to these elements of expense.
3. The effect of burden is displayed (lines 36, 37 and 38) in the transfer of variable burden charges to inventory at the budgeted 4.33 percent of sales value assigned to production. The remainder or period burden is contrasted against the budgeted period burden with a variance of $1,890 ($81,910 minus $80,020).
4. Direct labor is shown in total, in the amount charged to inventory, and in the resulting variance (lines 40, 41 and 42).

5. Direct materials and outside production are reflected in total, in the charge to inventory, and in the material variance (lines 44, 45 and 46).
6. Since the products of this manufacturer are of a standard nature, production can be assigned sales values (line 50). These values become the basis for all of the comparative percentages shown.
7. Other actual and budgeted statistics provided are direct labor hours, direct labor average hour rate, burden per budgeted direct labor dollar, and burden per budgeted direct labor hour.

From this type of report, it is convenient to obtain the conclusions necessary for the tightly controlled operation of each production department. It is particularly interesting to note that the cost responsibility statement here illustrated has been used in substantially the present form for three years in a firm of relatively small volume ($2\frac{1}{2}$ million dollars a year) and before the development of engineered labor standards.

Analysis of Variances

The materials, labor, and burden variances displayed in Exhibit 7, are all taken from the cost responsibility statement. The materials variance is shown as a single figure instead of being segregated into price, use, and product mix

Analysis of Variances
Product A Expenses
10 Periods

Materials Variance

Materials & Outside Production - at Standard	$460,620
" " " " - per Bills of Material	456,220
Materials Variance (Price, Use & Mix)	($4,400)

Labor Variances

Labor Performance (2,000 hrs. x $2.00 hr.)	$ 4,000
Labor Rate (65,000 hrs. x $.031 hr.)	2,000
Total Labor Variances	$ 6,000

Burden Variances

	Fixed	Variable	Total
Fixed Salary Expense	$600		
Variable Labor Expense		$(400)	
Other Variable Expense		1,340	
Other Fixed Expense	350		
	$950	$ 940	$1,890

EXHIBIT 7

variances. In the case under discussion, it is not found necessary to break down these variances, but it is relatively simple to separate them by orthodox procedure, using data on material requisitions and an analysis of the actual model mix with the product line against the budgeted model mix.

Labor variances, both performance and rate, can be readily isolated directly from the cost responsibility statement. A part of the performance variance may be due to model mix; when necessary, the two elements may be separated by the usual procedures. Burden variances for the various groups of fixed and variable expenses are segregated directly from the cost responsibility statement, as illustrated.

Price-Level Adjustments

Industrial accountants have an immediate challenge to become productive on still another frontier of report preparation and interpretation. The mounting effects of inflation and rising market values more and more are distorting, for decision-making purposes, the data set forth on conventional balance sheets and operating statements. While realizing the alarming impact of these distortions, accountants and executives have as yet done fairly little other than to talk and write of these problems. We will not deal with them at length here, because they and their remedies are of such significance that a complete article should be devoted to them. We have found most valuable the use of internal yearly financial reports which provide:

1. On the balance sheet, a comparison between book values and current values for inventories, land, buildings, machinery and equipment, and leaseholds.
2. On the operating statement, a series of adjustments to the conventional net income reflecting the effects of current-value changes on the balance sheet. These include adjustments for changes in current inventory values from year to year, increased depreciation due to current fixed asset values, and similar factors.
3. On the balance sheet, a series of ratio comparisons for book values and current values. Most significant is the comparison of net profit after taxes to net worth on the two bases.

With such reports, an operating executive can analyze his business *as though it had been purchased with current-value dollars*. It is not uncommon to find that the percentage of current-value net profit to current-value net worth does not begin to repay the risks of enterprise while hardly offering an adequate return on investment. Through current-value reports, the accountant can alert

his management to the underlying need for more volume, higher selling prices, or some logical combination of all these—if the business is to survive the financing of replacements for deteriorating equipment and facilities.

Productive Accountants

The foregoing exhibits have been presented to illustrate specific applications of the insight, enterprise and imagination to reporting which gives management of the company full support. Information issued gives executives what they need because the accountants who participated in its development learned all they could about the people who put the reports to work.

More and more frequently, the industrial accountant is asking how he can gain further insight into the top executive's perspective, his problems and his decision-making processes. Some answers to this highly pertinent question may be found:

1. *By personal observation* and study of the top executive's needs, attitudes, and personality with a given firm.
2. *By discussion* with men in top management activities and, particularly, with executives in the firm.
3. *By attending seminars and conferences* for top-management orientation now offered by universities throughout the country and by at least one national management association.
4. *By reading current books* dealing with top-management responsibilities, planning processes and time allocations.
5. *By intuitive self-projection* into the problem-solving processes and criteria of the top executive. A great deal is gained from asking oneself this question constantly: "How would *I* tackle the solution to this specific management problem?"

It is through such executive-attuned observations and activities that a growing number of industrial accountants are achieving, in a process of natural evolution, top management positions in a wide range of business concerns throughout the country.

A Profile of the Top Executive

A good profile of the top executive was given in a recent[2] article which dealt with the views of 950 members of the Young Presidents' Organization. These

[2] "10 Problems That Worry Presidents," Lyle M. Spencer, *Harvard Business Review*, November-December, 1955.

presidents analyzed their own performances and problems and outlined these ten problems which worry presidents most:

1. How to use their executive time effectively.
2. How *not* to be a doer (this calls for delegating authority and duties to others).
3. How to build a successful team.
4. How to set the direction for consistent company progress.
5. How to find expert advice (in a variety of specialized fields—including legal, tax, accounting, production, promotion, development, engineering, marketing).
6. How to secure necessary working capital.
7. How to make crisis decisions (and these are certainly times for crisis decisions in many industries).
8. How to negotiate—where big money is involved.
9. How to find a creed (a creed which is ethical, public spirited, and in the best interests of free enterprise).
10. How to effect self-improvement (the continuing search for better means to reduce executive anxieties and to solve the recurring problems just outlined).

It is important to observe whether the industrial accountant is helping with the first eight of these ten problem areas. He does this with conclusive reports, charts, financial background and "pin-point" projection in advance of, or at the moment of, executive need.

Tools of the Accountant's Productivity

To summarize, then, the accountant can help his management increasingly in aggressive action decisions, in contractive action decisions, or in any combination of these. His tools are:

1. Proficiency in accounting techniques.
2. Ability to motivate and manage the accounting workforce.
3. Insight into executive decision-making processes.
4. Enterprise or willingness to explore and explain deviations from performance or profit norms.
5. Perceptive imagination in presenting decision-making data.

In short, it may be said that insight, enterprise and imagination spell the difference between "just an accounting system" and a truly "productive accounting system."

Control of Fixed Assets in a Large Manufacturing Firm

by LEO W. YOCHUM

THE CONTROL of fixed assets at Westinghouse Electric Corporation is a substantial task. In order to appreciate the magnitude of the problem, an introduction to the operation at Westinghouse follows:

Since 1886, Westinghouse has manufactured equipment for the generation, distribution, control and utilization of electric power. The company's first plant, with 20,000 square feet of floor space available, manufactured 13 products, all of which were advertised by means of a penny postcard. Today, the company's total of 62 major manufacturing plants and 44 manufacturing and repair (service) plants from coast to coast, which make 300,000 variations of 8,000 basic products, contain an aggregate of 41,000,000 square feet of floor space—enough to house 860 football fields. In addition, 143 sales offices are maintained throughout the nation.

With that background, the subject of controlling fixed assets at Westinghouse will now be pursued.

The Annual Facilities Program

It is axiomatic that effective control of fixed assets begins with the proper planning for facilities expenditures. Consequently, an annual facilities program has been developed. In order to understand what is included in this program, it is necessary to define facilities expenditures. They are:

1. Expenditures to acquire land, buildings and capital equipment, whether by purchase, by construction or by long-term lease.
2. Nonrecurring expense directly associated with facilities projects such as rearrangement expense and, in the case of new activities, training programs, transfer of employes, and overhead costs up to the date when shipments are expected to begin. Ordinary maintenance of facilities and other expense items customarily embraced in departmental expense budgets are not included.
3. Expenditures to accomplish substantial alterations or rearrangements in connection with buildings or capital equipment. (The

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term "substantial," as used here, means $10,000 or more. So rearrangement projects of less than $10,000, if entirely "expense," are not included under the heading of facilities expenditures.)

This program, initiated annually by each division within the company, entails a complete listing of the proposed facilities for the ensuing year. All projects of less than one million dollars included in the facilities program, are listed in complete detail. It also includes any proposed expenditure over one million dollars for the next five years, detailing the year in which the expenditure is to be made.

Each operating division, in developing its facilities program, must group its projects in one of four classes from the following classification:

Class 1—*Expansion projects*—those primarily intended to provide greater output or to manufacture new products.

Class 2—*Product improvement projects*—primarily developed in support of project redesign or broadening of line primarily for purpose of improved salability.

Class 3—*Cost reduction projects*—primarily intended to reduce costs or expenses by improvement of facilities to achieve reduction in materials or expenses.

Class 4—*Necessity projects*—essential to operations, not lending themselves to classification in one of the three above classes.

Justification of the Expenditure; Requests and Approvals

A sufficient justification for the expenditure, detailed for each project, is of equal importance. These same four project classes have specified requirements for justification of the expenditure. The requirements by class are:

Expansion projects must result in increased sales volume, profit and adequate return on investment.

Product improvement projects must be supported by data on competitive standing of product lines with respect to needed improvements.

Cost reduction projects must be supported by the estimated return compared to the 20-percent standard as established by corporate policy.

Necessity project must be accompanied by a statement of reasons for and benefits of the project.

Prior to outlining the sequence of approval for facilities requests, it might be well to point out that the profit responsibility rests with each division of the company. All divisions are classified in one of six groups, each group having a general manager.

Each operating division's facilities requests are forwarded to its group general

manager for review and submittal to the corporate planning committee. The consolidated requirements of all operating divisions are evaluated by the planning committee in the light of the corporate funds available for facilities expenditures. The facilities programs are adjusted within the framework of expendable funds and deletion of projects occurs, for the most part, on the basis of inability to produce adequate return on investment. The consolidated program, as recommended by the planning committee, is submitted to the management committee and then to the board of directors for approval.

At this time, the board of directors is requested to authorize local management to proceed (without further board approval) with projects of less than $100,000.

All facilities expenditures, even though included in the approved facilities program, must be authorized by an approved appropriation before the project can be undertaken. The request and approval of the appropriation is the second step in the four-part discussion on controlling fixed assets. The appropriation request includes a comprehensive description of the project and a resumé of the purpose and the expected benefits, and also provides for the necessary approval signatures.

The approval of appropriation requests follow this course for all projects included in the current facilities program. Projects under $100,000 are finally approved by the division manager and projects over this amount must be approved by the division manager, the respective group general manager, the planning committee and, finally, by the board of directors.

Project substitutions for projects included in the original facilities program are approved locally by the division manager, if less than $50,000. Substitute projects from 50 to 100 thousand dollars require the approval of the division manager and the group general manager; those in excess of $100,000 require the same approvals as the original appropriation. Insofar as appropriation revisions are concerned, generally the same approval sequence is followed.

After the appropriation request is approved, the project can be undertaken. It is at this point that the control of the actual expenditure begins.

The Control of Expenditures and Assets

To control the expenditures for capital equipment, expenditure orders are entered against the approved appropriation at any time before the closing date of the appropriation. The expenditure order must not exceed the approved amount of the appropriation and must be approved by the division manager and the local manager of accounting. The divisional manager of accounting has the

responsibility for determining that the anticipated expenditure is in complete compliance with the original appropriation and sets the accounting control of fixed assets in motion.

The initial step in the financial control of fixed assets begins at the division level. Costs relative to each expenditure order are accumulated in a construction-in-progress account. The expense portion of this account is cleared to operations monthly and the capital portion is shown as construction-in-progress on the local books of account.

When installation of a given project is completed, the division manager of accounting, who has the responsibility for capitalizing the project, must advise headquarters as to whether all fixed assets have been recorded on the centralized master file maintained on an electronic computer.

Processing the Data

Under the previous system, a centralized file on punched cards was maintained at headquarters with all divisions supplying information on manually prepared cards. Under this system, it was necessary for the sending division to compute depreciation and the date on which depreciation was to stop for each item. To simplify the procedure, a base date was established, from which the accumulated reserve could be calculated monthly and hence monthly depreciation charged ascertained. Considering that the property record contained 150 thousand cards, the time consumed for the preparation of the necessary data relevant to the property record alone was great, so that the system did not have built into it the facility for the preparation of the many necessary by-product reports. With the increased need for Federal, state and local tax reports, another master file of tabulating cards of the same size was developed in order to simplify and speed up the preparation of these by-product reports.

After the creation of the second master file, the company was confronted with the task of controlling 300 thousand tabulating cards to obtain the required information. In 1954, the company adopted the sum-of-the-years' digits method and the declining-balance method of depreciation, in addition to retaining the straight-line method. With the advent of this change, it became increasingly important to look for better ways and means of controlling our property records. In January, 1956, these records were transferred to the electronic computer, while our centralized master file concept was maintained. The present master file, housed in the computer on magnetic tape, has the following information for approximately 150 thousand items representing more than 750 million dollars in total fixed assets: 5-digit account number, 4-digit installation date, 19-character alphabetical description, 6-digit tool number, 4-digit divisional location code,

1-digit code identifying one of three methods of depreciation, 3-digit cost center, a 2-digit section, cost, accumulated reserve, net book value and the monthly depreciation rate. With this notion of the master file in mind, a review of the situation before going into the subject of how the computer fits into the over-all picture is worthwhile.

At the time a given project is completed, it is the division manager's responsibility to establish the date of capitalization, the account, the method of depreciation and the cost, and to furnish to headquarters each month, in coded fashion, the information relative to each item being capitalized, for entry to the computer. The local accounting department is not required to make any additional records other than maintaining sufficient data for distribution of depreciation.

In installing the use of the computer with its absolute requirement that all data entered on it be coded and uniform, it was necessary to prepare complete instructions enumerating all possible conditions and specifying the coded information needed for up-dating the master file. This file is up-dated monthly by the receipt of properly coded information from the divisions. The information is received at headquarters on a rigidly controlled schedule. Punched cards are created for each change which are, in turn, converted to magnetic tape for entry to the master file.

The method used for up-dating the file for existing items precludes the possibility of error in that the computer will automatically reject any item or change that does not match entirely with the item being changed. Before the computer effects the change in an existing item, it examines the entered change to ensure that the following five elements are in complete agreement: tool number, cost, location, account number and installation date. This combination ensures the uniqueness of every item on the master file. Obviously, in the case of additions to the master file, it is not possible to detect all human-element error but the computer, before entering the addition to the master file, examines the item to determine that all information required is being entered and that the tool number has not been duplicated.

For each new item the computer records the information required on the master file and, in addition, develops the monthly depreciation. Some four thousand changes are entered on the computer each month. After up-dating the file for all changes, the computer calculates the depreciation for each of the 150,000 items and develops the new accumulated reserve and the new net book value. In developing the depreciation, it is necessary, for all items being depreciated under the sum-of-the-years' digits and the declining-balance methods, that the computer analyze the anniversary date to determine if a new rate should be effected.

Each division is furnished with a complete record of all changes and additions made to the master file. Upon completion of this up-dating process, a report by each of some 300 location breakdowns is prepared, showing the account, the cost, the accumulated reserve, the net book value and the depreciation charged for that month. This report is a complete up-dated property record for each division.

The speed, the accuracy and the volume of this monthly operation can be demonstrated by the following: On the 12th working day of each month headquarters is advised by the divisions of over 4,000 changes to be made to the master record. Seven days later, 62 divisions have in their possession a complete listing, with all the data for that month for each of the items under their control. This report is completely reconciled and balanced monthly.

Advantages

As mentioned earlier, one of the reasons for adopting the use of the computer was to facilitate the preparation of many by-product reports. Since the computer has a tremendous appetite for volume, it was not difficult to house the information on it with sufficient codes to enable us to prepare these reports. For example, the divisions are not required to develop and maintain tool listings at their locations since the centralized computer furnishes semi-annually a complete listing of all tools. In addition, tool listings for plant and property inventory purposes can be produced upon the request of the division. An example of some of the other reports issued as an adjunct to the property record are:

1. Age analysis of all facilities. This report is used by the manufacturing people in the determination of acquisitions, retirements and replacements of fixed assets.
2. Tool listings by cost center—used by the cost accounting department.
3. Tax reports. These reports are many and varied, ranging from information for preparing the necessary depreciation schedules for the Federal tax return to information necessary for the Pennsylvania capital stock tax report, etc.

Our present program has reduced clerical effort and provided sufficient flexibility so as to furnish the various analysis and reports which constantly changing conditions have required. Something less than the computer approach would hardly permit the flexibility and the speed required for the accounting control of our company's fixed assets.

Pitfalls of Statistical Models

by F. R. LIGHT*

THE ACCOUNTANT has made substantial progress in his profession through the utilization of sophisticated statistical models coupled with the speed and accuracy of electronic computers. Unfortunately the answers derived from these modern devices carry implications of authority and finality which sometimes lure us into believing we have the only and ultimate solution to a problem. Special formulas and equipment lack "human judgment" and consequently cannot make decisions but can only supply data necessary for the decision-making process.

Dangers in the Use of Standard Deviations

A case in point is Mr. Paul C. Taylor's article, "Keeping the Sales Budget Current With a Small Dose of Statistics," published in the September 1959 issue of the *Bulletin* Mr. Taylor points out that by setting up authorized standard deviations from the sales budget (for example, plus or minus 10 percent) the accountant would have a built-in alarm system to signal the need for a sales budget revision—the plan being to rejuvenate the budget once actual variances fall outside the perimeters of the authorized standard deviation. An obvious danger in the indiscriminate use of this plan is that variances could be compensating and, therefore, not be highlighted because the net variance would fall within the prescribed limits. To illustrate this possibility, a radical example is scheduled below indicating how an unfavorable price variance can be offset by a favorable volume variance:

Sales budget	100 units	@ $30.00 =	$3,000
Actual sales	150 units	@ 20.00 =	3,000
	50	($10.00)	-0-

In a case such as this, without proper analysis, one could be led to believe that actual sales are according to plan —when in fact the company is experiencing what may be a serious price deterioration problem.

Fallacies in the Use of Extrapolation Techniques

Another situation similar to the one just illustrated is the utilization of statistical techniques in extrapolating financial figures and blindly using the results of the computation as the forecast sales. A classic example of the inadequacy of such information is provided by the buggy whip business, where before the advent of the automobile it could have been proven statistically that future sales would

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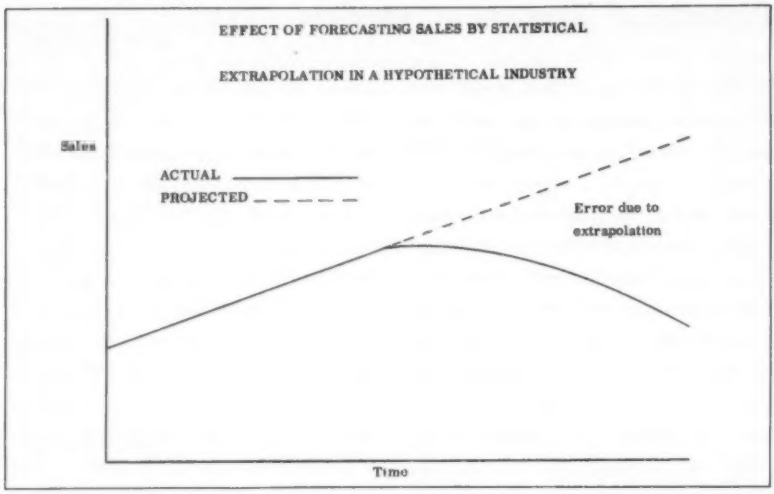

EXHIBIT 1

equal or exceed those previously experienced.

The effect of this arbitrary mathematical assumption in a hypothetical industry is depicted in Exhibit 1.

Should Statistical Models Be Abandoned?

The writer is a strong proponent of the utilization of statistical models and the services offered by electronic computers, but the accountant must be keenly aware that they are merely tools—the means, not the end. Basically these devices are as good as the information which is fed into them. A mechanical formula can cope only with a question amenable to a yes or no answer. In addition, any element of the formula must be expressed in mathematical terms. In actual practice, the accountant must frequently make projections that involve qualitative (judgment) factors as well as quantitative ones.

The accountant's ultimate responsibility in projecting sales or other financial figures is to be as realistic as possible. We recognize that the accountant must not turn his back on modern means of speed and accuracy. However, he is derelict in his duties if he considers a tabulating report or the answer derived from a statistical formula as the final product of his financial control efforts. He must exercise due judgment and inject his thinking into the finished product—the finished product being an intelligent report which will assist management in attaining the profit objectives of the company.

Product Costing for a Meat Packer

by DONALD F. TIMMONS

THE ASSIGNMENT of costs to individual products in the line is perhaps one of the most vexing and perplexing problems the accountant may face. In the food industry, where process costing is used and high volume, low markup condition is the rule rather than the exception, the problem is extremely acute. In the meat packing industry the processing evaluation is further complicated by joint and co-products, by-products, weight-loss and weight-gain, as raw materials move through the plant.

Industry interest has been centered, in recent years, upon developing unit costs of products. Departmental profit and loss statements are fairly commonplace today and the usual acceptable cost accounting methods of allocation of expenses are employed, although perhaps not as widely as the outside world may think. However, such a departmentalization of costs has been assumed here. Further, we will not concern ourselves with conversion costs, i.e., raw material and direct labor costs. Instead, we shall attempt to explain how one packer assigns overhead cost to the products produced within a department.

For many years we, as others in our industry, relied on so-called test-costs; by use of current prices a raw material price was calculated on a selected lot of product, giving due weight to the yield from fresh to finished weight; by timing the various steps involved and applying a wage rate, direct labor was obtained; an estimated overhead, based upon past history, was applied, being either a plant or department-wide rate calculated on total tonnage of all products. In view of shrinking profit margins and rising labor and overhead costs, it has been only natural that cost determination within a department and, more specifically, on a product level has been a subject of intense interest to operating and accounting management in the industry.

Method of Allocation: Classification of Overhead

Several years ago, when we redesigned our cost system, it seemed to us that the assignment of overhead to product fits the theory of use of facilities. A product is manufactured by using machinery, smokehouses, coolers and freezers, etc. This use covers a time span that starts with receipt of the product and, for

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manufacturing purposes, ends when the finished product is placed in the sales cooler, available for sale. Since time (or direct productive labor) constitutes a measure of use of facilities for manufacturing, it appeared logical to assign overhead on this basis. Tonnage, a commonly used method of assigning overhead to product, did not seem appropriate since in this method no weight is given to the length of time any given product is in the production process. As an example, two smokehouses are filled, each with a different product. One product takes six hours for smoking whereas the other takes only four hours. Moreover, depending upon the size and shape of the products, one may weigh more than the other while they are in the smokehouses. Surely, or so it was reasoned, tonnage would not be an equitable method of assigning smoking costs to individual products.

Having thus decided upon the method of allocation, attention was turned to the classification of all overhead costs into fixed and variable. This is most needed in an industry which is constantly selling product at a price that will produce a "contribution to overhead."

All elements of overhead, manufacturing, selling, shipping, delivery, and administrative, were divided into those that are sales-made and those that are management-made. Broadly speaking, sales-made costs are variable since they occur in proportion to sales. Management-made costs have been determined as a result of management decision and are, therefore, fixed in nature. There is some overlap in these areas that we worked out by analysis.

The starting point for a standard cost system must be a sales forecast, and on a quarterly rather than an annual basis, for some products in the line, because of price and supply performance, are so erratic in nature as to make long-term projections very difficult. The sales are forecast by weight for each product in the line and are assembled by department. The quarterly sales thus forecast are then broken down by weeks, allowing for holiday weeks and any known factors that might influence the sales mix.

After the initial compilation of all overhead expense, as well as its classification into fixed and variable have been completed, it is further allocated by individual items to departments on predetermined bases of allocation. Typical of these bases would be number of employees in the department, square footage occupied by the department, etc. After this is accomplished, each department has a dollar amount of both variable and fixed overhead allocated to it.

Determining the Variable Overhead Rate

The next step is to determine the variable overhead rate per pound of product. Since our manufacturing overhead is absorbed on the basis of direct labor hours,

it follows that different products within a department will have different overhead rates. The procedure for determining variable overhead is as follows:

Quarterly sales forecast—in pounds of Product A $\times$ Earned-hour factor = Quarterly standard direct labor hours of Product A (QSDLH)

$$\frac{\text{QSDLH — Prod. A}}{\text{QSDLH — All Products}} \times \text{Dept. variable overhead}$$

$$\frac{\text{Variable overhead dollars of Product A}}{\text{Quarterly sales forecast lbs. of Prod. A}} = \text{Variable overhead per lb. of Prod. A}$$

Thus, as an illustration, assume that three products are produced in Department X; the calculation of variable overheads for each product in the department would appear as in Exhibit 1.

Quarterly Forecast Sales Pounds and

Variable Overhead Rate Determination

Department X

Product	Sales lbs.	Time factor per lb.	Standard direct labor hours	Variable overhead expense $	Variable overhead rate per lb.
Product A	400,000	.0246	9,840	33,396	.0835
Product B	600,000	.0445	26,700	90,617	.1510
Product C	550,000	.0166	9,130	30,987	.0562
Total	1,550,000		45,670	155,000	

EXHIBIT 1

The calculation of fixed overhead would be accomplished by spreading the total quarterly fixed overhead dollars equally over each week in the quarter. By dividing the weekly fixed cost by the tonnage for the week, fixed overhead rate per pound is then established.

Calculations Narrowed Down to Effects

Now that the fixed and variable overheads have been ascertained for the upcoming period, two analyses may be made weekly by management. First, the results for the previous week may be calculated and tonnage and costs may be compared against the forecasts. From this the selling efficiency and ability of the sales department and its individual salesmen may be measured. Deficiencies can then be brought to the attention of sales executives for their action.

As an example, a summary of unit costs and margins for Department X products sold in a week is given below:

Product	*Conversion costs*	*Variable overhead*	*Total direct costs*	*Average sales realization*	*Gross margin*	*Fixed overhead*	*Profit or loss*
Product A	.2640	.0835	.3475	.4450	.0975	.0410	.0565
Product B	.2320	.1510	.3830	.3830	.1430	.0569	.0861
Product C	.2940	.0562	.3502	.3702	.0200	.0298	(.0098)

Thus, it can be pointed out that, though the sales department failed to move Product C at an over-all profit, the loss was somewhat reduced by its selling more pounds than were forecast.

By this method the effect of volume, or its lack, on the fixed cost of each product may be determined, as in the following illustration:

CALCULATION OF FIXED OVERHEAD RATE BY PRODUCT

For Week *Ending* Sept. 16, 1960

	Sales lbs. per week		*Predetermined fixed overhead rate*	*Fixed overhead rate w/e 9/16/60*
Product	*Forecast*	*Actual*		
Product A	15,000	15,000	.0410	.0410
Product B	50,000	42,000	.0478	.0569
Product C	38,000	40,000	.0314	.0298

Use in Pricing and in Sales Evaluation

It is obvious that this procedure will serve to develop costs on past performance, but a similar analysis might be made in advance. Suppose, for example, a special sale on Product C was contemplated by the sales department for the week of September 23. The sales forecast when originally prepared did not provide for this special sale. The sales department wants to know how much the fixed overhead rate will be affected if the sales exceed the forecast by 10,000

pounds, because, to sell the increased quantity, it will be necessary to shave the selling price slightly.

The calculation of the savings on the fixed overhead rate may be accomplished algebraically by use of the following:

Let x = sales pounds forecast — a = sales pounds variancce
y = fixed overhead rate — b = rate variance on fixed overhead

The formula for determining the rate change may be stated as:

$$y\,(x \pm a) - b\,(x \pm a) = xy$$

Solving for b under the condition that a is a plus factor,

$$b = \frac{ay}{x+a}$$

By substituting values and solving the formula it is found that 10,000 additional pounds of Product C would lower the fixed overhead rate on that product by .0076 per pound.

Based upon the sales realization and direct costs for the preceding week, the total unit cost for the coming week on Product C can be projected as follows:

Total direct costs	.3502
Fixed overhead	.0341
	.3843
Less: Reduction in fixed cost due to 10,000 lbs. to be sold over forecast	.0076
Total cost of Product C	.3767
Less: Sales realization w/e 1/9/16	.3702
Increase in sales price to break even	.0065

Since the meat packer deals in a highly perishable market, he is frequently faced with the problem of determining the lowest price at which he can sell a quantity of product and at the same time make a profit and dispose of excess product. Unfortunately, the principles of variable and fixed costs applied to individual products have seldom been utilized in a situation such as the one above described. Sometimes, of course, this so-called "distress selling" must be done immediately and for whatever price the sales department may be able to get. More often, however, the accounting department could supply information that could enable the sales department to move the product and still show a small profit.

As an illustration, let us assume that forecast sales pounds for Product C in the week of September 23 were 35,000 and there are 80,000 pounds of the

product available for sale. What is the lowest price at which the product may be sold and still return a profit of .0025 per pound? The price may be calculated as follows:

Total direct costs	.3502
Fixed overhead	.0149
Profit	.0025
Sales price	.3676

The opportunity for a small profit on disposition of this product still exists. At worst, we know that we cannot sell the product below $.3502 per pound without losing money.

The most important advantage of product costing done in this manner is the fact that each product stands by itself. Measurement of past performance and charting of future performance can be done product by product. And finally, the selling effort of the sales department and the individual salesmen may be pinpointed more definitely.

Monthly Unit Costs—Are They Still Significant?

by JOHN DEARDEN

AT ONE TIME, unit cost data was management's principal source of information on the financial effects of factory operations. Today, as the result of developments in control techniques, it has been my observation that the calculation of monthly unit costs is generally a waste of time and money. Moreover, management's use of monthly unit cost data may lead to incorrect decisions in many cases.

This will be considered heresy by many a cost accountant because it implies that much of the work he is currently doing is unnecessary or even harmful. The reasons in support of this rather unorthodox assertion will be developed in this article, by taking each of the principal purposes of a cost accounting system and showing either how monthly unit costs do not accomplish these purposes at all or how some other method will do it better (and usually cheaper). It will be shown how the calculation of monthly unit costs has the following two adverse effects:

1. Management may not be provided with all of the available data for making correct decisions or, still worse, the monthly unit cost data may lead to incorrect decisions.
2. The cost accounting system may be unduly expensive to operate because it is generating unnecessary data.

Functions of a Cost Accounting System

Cost accounting systems provide data for three major purposes: inventory valuation, cost control, and revenue decisions. Each is described below.

Inventory valuation. Unit costs are necessary for the calculations of the value of work-in-process and finished goods inventories which, in turn, is used in the calculations of the income for the period. Inventory valuation was the original reason for the cost accounting; it is still largely its basic purpose. In those cases, however, where it is clearly understood that this is the principal purpose, the accounting system should be adapted to it so that the necessary information can be obtained as efficiently as possible.

Cost control. A second purpose of cost accounting is to provide management

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with information that will enable it to control costs. In its most primitive form, cost accounting provides management only with the actual costs of operation, by various cost categories, for some period of time. In more effective form, cost accounting provides reports that relate actual costs to previously accepted (and preferably engineered) standards of performance; these reports are accompanied by analysis of the variances from standards.

Revenue decisions. The third function of cost accounting is to provide management with data for making revenue decisions. Revenue decisions can be classified into pricing decisions and product decisions. Information on unit costs may be required to assist management in making decisions with respect to the level of the selling prices. For example, material costs may have increased. If it is possible to pass on the cost increases to the customer, management will wish to be informed as to impact of these increases on the unit costs as soon as they occur, so that prices may be adjusted accordingly. Another situation could occur when competition is forcing prices downward. Management needs unit cost data to determine the point at which it is no longer economical to continue production. Management needs to know the profitability of the parts being produced in order to make forward product plans. The decision to expand the production of some lines and curtail the production of others will be influenced to a considerable extent by their expected profitability. Unit cost estimates are required to calculate this profitability. (A somewhat similar situation is the use of unit cost data in make-or-buy decisions.)

It is not necessary for a cost accounting system to accomplish all of the three purposes described above. It is important, however, to decide precisely what the cost accounting system is supposed to accomplish and design it accordingly. There is nothing necessarily wrong with a cost accounting system that provides no data for cost control or for making revenue decisions. Particularly in small businesses, these functions may be handled by management without detailed accounting data. For example, in a small shop, the owner-manager can control direct labor costs by merely observing the number of persons working. If a cost accounting system is not supposed to provide for cost control, it is important that this fact be clearly understood and the system designed accordingly. The worst situation generally occurs when the cost accounting system provides inadequate data for cost control or revenue decisions. Not only is management deprived of necessary information and required to use inadequate data, but, frequently, the system is as expensive to operate as the one that provides more useful data.

In evaluating the effectiveness of a cost accounting system, the first step is to determine precisely what it is supposed to accomplish. The next step is to see

how effective the system is in accomplishing these purposes. At this point, the contribution of monthly unit cost data should be carefully examined. In most cost accounting systems, I believe, a careful study would show that unit cost data contribute little to the effectiveness of cost control, and, further, that they neither serve as a good basis for revenue decisions, nor are necessary for interim financial statements. In the next three sections of this article, the contribution of monthly unit costs to each of the cost accounting functions will be examined.

Monthly Unit Costs for Inventory Valuation

Let us start with the assumption that the only function of the monthly unit cost data is to value inventories. The desirability of using monthly unit costs for inventory valuation, depends on the answers to the following questions:

1. Are the monthly financial statements useful?
2. If monthly financial statements are required, are traditional cost accounting procedures the best and most efficient means for obtaining these statements?

Monthly unit costs are calculated to obtain the month-end inventory value; month-end inventories are used in the preparation of the monthly income statement. In deciding whether unit costs should be calculated each month, it is necessary to decide first whether monthly income statements are useful. To many, the idea of not having monthly financial statements will seem a radical departure from traditional accounting practice. However, there are many instances where the monthly accounting routine is followed blindly, in spite of the fact that monthly income statements are no help to management. If monthly financial statements can be eliminated, the work of adjusting and closing the books and preparing financial statements can be eliminated.

If monthly financial statements are required, is it necessary to calculate each month the unit cost of products produced during the month? In most cases, an accurate approximation of monthly profits can be obtained without traditional accounting detail, including the calculation of monthly unit costs. Three examples will be used to demonstrate this point.

The first case is one in which inventories are small in proportion to the monthly production or the change in the level of inventories is small from month to month. (This situation frequently exists where there is no finished goods, and work-in process inventories can be eliminated by using the cost of production to approximate the cost of sales.)

The second case is one in which the change in inventory level is significant

from month to month but production costs are relatively stable. In this case, monthly profits can be approximated as follows:

1. Calculate the variable cost per unit for the previous year (or six months, if this is representative);
2. Adjust these costs for any significant changes in the level of material price or wage rates as well as for abnormalities in the base period;
3. Multiply the adjusted unit costs by the number of units sold;
4. Add the actual fixed costs of production;
5. The resulting figure is the cost of sales.

The monthly profit obtained by the method described above will be similar to that obtained from a direct costing system. It is my opinion that profits calculated in this manner are most useful to management. If a company does not use a direct costing system for its annual financial statements, however, it may be desirable to have the monthly profits consistent with the annual statements. In this case, instead of using the variable cost in Item 3, above, use total unit costs. The under or over-absorbed overhead can be calculated as follows:

1. Multiply the monthly fixed costs by the ratio "actual volume divided by standard volume." (The volume should be expressed in some common unit such as direct labor hours.)
2. Subtract the amount obtained from the total monthly fixed cost. (A negative amount will be over-absorbed overhead, a positive amount under-absorbed overhead.)

The third case is one in which significant fluctuations occur in the month-to-month production efficiency. In this situation, management needs some means for controlling production costs on a current basis, i.e., to know, at least, when current cost levels have reached a point where action is necessary. (If cost control techniques are unnecessary, it would hardly be likely that monthly profit statements were required.)

In this case, unit costs can be based on the standards used to control production cost levels. Unit costs are calculated statistically in a manner similar to that described in Case 2 except that the costs are based on the production standards rather than on the previous year's average. In addition to the calculations described, the cost of sales is adjusted for the amount that actual costs are over or under standard, which figure can be taken directly from the cost performance reports.

From the foregoing it may be concluded that the calculation of monthly unit costs is rarely needed for the calculation of monthly profits and that, if monthly

profits are required, approximations can be made without calculating unit costs each month. Many will disagree with this since such a statistical approximation does not give "actual" profits. It may be argued that actual profits are not absolute in any sense but are subject to the method of calculation. The cost accountant has a wide range of possible methods to use; actual profits are, therefore, the result of his decision as to method of calculation. Even within a standard cost system, the amount of profit will vary with the standards employed.

The fluctuations in profits caused by application of different methods become relatively greater as the period of time covered becomes smaller. (Theoretically, all accounting methods will result in identical profits over the entire life of a business; over a shorter period of time, however, the results may be widely different.) Consequently, monthly profits are rough approximations at best and these approximations are not necessarily improved by the additional time and effort required for use of traditional cost accounting procedures.

Not only are monthly profits of limited value to management, because of their approximate nature, but also profit reports, which are received often so long after the close of the month that the information has no possible use as a control tool. The recommended statistically developed monthly profits can be published very soon after the close of the month: first, because it is not necessary to wait until the books are closed; secondly, because much of the work can be done before the end of the month. Furthermore, these methods are especially adaptable for forecasting profits, the control information that management actually needs.

Monthly Unit Costs for Cost Control

The second function of cost accounting is to provide information to assist management in controlling costs. The question is whether monthly unit costs contribute to the cost control function or not.

The usual way in which unit costs are used in cost control reports is to provide management with the current month's unit costs compared to some previous period or, in standard cost systems, with a standard. If no standard is used, management is provided only with information concerning the change in unit cost—there is no information as to whether the absolute level is satisfactory. If standard costs are used, management will know only the extent to which the cost level is satisfactory. In either case, unit cost data will only raise questions; they will not answer them. Consequently, management must look elsewhere for the answers. For example, if the cost of an item has increased this month, management must find out which element of cost has increased, what is the

cause of the increase and who is responsible, before it can be decided what action, if any, should be taken. Furthermore, management is more interested in the total effect of the cost change than in its impact on any particular unit. (A large cost increase in a low volume part may not be as important as a small increase in a high volume part.) The information that management needs for cost control will be available on the budget performance reports. On these reports, costs are accumulated by the individuals responsible for the expenditures, the actual costs are compared to a budget or standard in total and variances are explained. Superimposing a unit cost report on this system adds nothing to the control of costs and may even be confusing to management. On the other hand, monthly unit costs themselves, without budgetary control reports, are almost always inadequate costs control tools. However, an exception to this may be noted. If several departments or plants produce a homogeneous product, unit costs make a useful common denominator for comparing relative performance but, even then, monthly costs have limited value because short-term random factors frequently distort the comparisons.

The conclusion is self-evident, i.e., monthly unit costs contribute little or nothing to the cost control function of a cost accounting system.

Monthly Unit Costs and Revenue Decisions

The third function of cost accounting is to provide management with information for making decisions involving selling prices and product mix. The former includes such decisions as pricing a new product, repricing an existing product that has been changed in design, determining how much of a cost increase can be passed on to the customer, or deciding whether to meet a price reduction made by a competitor. The latter includes selection of the products on which to expand or to curtail production.

Revenue decisions require estimates of future costs. What is specifically needed is the average unit cost that will prevail over the period involved. Since no one can predict the future with certainty, this objective can never be fully realized. It is important, however, to keep intention constantly in mind when providing management with unit cost information for revenue decisions. Historical unit costs are useful only if they provide the best possible basis for estimating future unit costs.

Monthly unit costs are almost never necessary for making revenue decisions. Average annual unit costs, adjusted for changes in the level of material prices and wage rates, provide a much sounder basis for forecasting the future level of unit costs than does a monthly unit cost figure. First, the monthly unit cost

is influenced by random factors to a much greater extent than the annual unit cost figure. Take, for example, the problem of determining month-end work-in-process inventory. At the end of the fiscal year, a complete physical inventory is taken; at month end, however, a quick approximation is all that usually can be made; yet, the effect of a mistake in the inventory value on the monthly unit cost will be about 12 times that on the annual average unit cost.

A second reason why annual unit costs are better than monthly unit costs for revenue decisions is that it is practical to make more refined estimates if it is done only once a year. Because of the clerical work, most cost accounting systems are limited to a fairly small number of cost centers. The usual cost center is a department because this is the ledger subdivision required for cost control. (That is, if the department manager is to be held responsible for his costs, the ledger must be maintained in such a way that a record is kept of his expenditures.) An overhead rate is established for each department and products produced in the department are assigned a share of the overhead costs based on this rate. Frequently, however, products produced in the same department may require quite different production processes.

For example, in a metal stamping department some parts may be produced with automatic equipment such as air ejectors and iron hands; other parts in the same department may be fed into and removed from the presses by hand. The latter would have a much greater amount of direct labor and a single departmental overhead rate would result in overcosting the parts produced on the nonautomatic equipment while undercosting the parts produced on the automatic equipment. Another common situation is one in which a department has both machinery and assembly operations. Because assembly operations usually generate lower overhead costs than machining operations, distortions in unit costs can occur. For example, if Product A takes two hours of machine labor and Product B one hour of machine labor and one hour of assembly labor, each part will have the same overhead cost if a single overhead rate is used. If, however, the department was divided into two burden centers, Product B would cost less than Product A.

As long as the mix of products is reasonably constant, the situations described in the previous paragraph will create no problems in the inventory valuation and cost control functions of cost accounting. These situations could, however, create serious problems in making revenue decisions. For example, management could be misled as to which products are profitable and which products are losing money, price differentials between products could be distorted, or the production of Product A could be incorrectly dropped or expanded.

One solution, of course, is to increase the number of cost centers to the extent

necessary to make the production within each cost center homogeneous. Frequently, the clerical cost of doing this is prohibitive. Even if it is not, there is a better solution: unit costs developed analytically from engineering standards and historical cost data are better (and usually cheaper) for making revenue decisions than are the monthly unit costs generated by the typical cost accounting system.

The methods for developing unit costs analytically are similar to the methods used to develop standard costs, which usually make an excellent basis for making revenue decisions. Standard material and direct labor are almost always satisfactory; standard overhead rate, however, will be satisfactory only if the cost centers are homogeneous. If not, the cost centers may be subdivided analytically for the purpose of estimating unit costs more exactly. The actual cost accounting would not have to be changed. For example, take the case in which a department has both machining and assembly operations. It may be possible to calculate from other operations in the plant that assembly operations generated an overhead rate of about 100 percent. In calculating the overhead rate for the machining operations of this cost center, the total budgeted overhead of the department can be relieved of costs equal to 100 percent of the assembly direct labor; the remainder is assumed to be entirely applicable to the machining operations. The machining burden rate is this amount divided by the machining direct labor. This method may not be completely exact but it is infinitely superior to using one overhead rate for all operations in the department.

Another method for assigning burden is to determine a burden rate by type of operation, without regard to the department in which the part is produced. For example, the operations of a factory can be subdivided into the following types of operations: fully automated machining, semi-automated machining, nonautomated machining, heavy assembly and light assembly. (The rates can also be divided into their fixed and variable elements.) The relation of burden cost to direct labor cost for each of these operations is estimated and the percentages adjusted so that all of the budgeted overhead will be absorbed at standard volume. Unit overhead costs are calculated by applying these rates to the labor cost for each type of operation.

As illustrated, it is clear that monthly unit costs are not necessary for making revenue decisions; costs developed analytically in the manner described in this section provide a better basis for revenue decisions. Even if unit costs generated by the cost accounting system are to be used, the average cost for the past year still provides a better basis for making revenue decisions than does the monthly unit costs.

Summary

It has been demonstrated why monthly unit costs may be of little or no use in either controlling costs or making revenue decisions. Furthermore, if monthly financial statements are necessary, satisfactory monthly profit estimates can be made without the expense of calculating monthly unit costs. Consequently, the calculation of monthly unit costs can be eliminated from almost all cost accounting systems.

Because the typical standard cost accounting system does not provide monthly unit costs, it might be interpreted that this article is recommending the universal adoption of standard cost accounting techniques. Although it is true that the problems discussed in this article can frequently be solved through the use of a standard cost system, it by no means follows that all companies should adopt a standard cost system. For example, if a company uses cost accounting data solely to obtain the monthly profit figure, the cost accounting system can be greatly simplified by methods described in the second section of the article; there may be no advantage in adopting a standard cost accounting system. Exceptionally, however, monthly unit costs may be useful and necessary, but if a cost accounting system generates monthly unit costs, this system should be examined critically as to (1) what purposes these unit costs are supposed to serve, (2) whether or not these purposes are, in fact, being served and (3) whether there are better (and cheaper) methods for accomplishing these purposes.

The Case of the Frustrated Accountant

(with Apologies to Erle Stanley Gardner)

by JAMES WILLETTE*

MR. JOHN W. MILES began his excellent article ("The great Game of Cost Reduction," in the May 1960 issue of the *Bulletin)* with the remark that "Cost accountants have a reputation, probably deserved, for being frustrated." He then proceeded to outline a suggested approach for easing that frustration in terms of better selling of the cost reduction programs about which his hypothetical accountant is apparently losing much sleep. It seems to me that Mr. Miles, as stimulating as his analogy of the "great game of cost reduction" certainly is, overlooks the fact that he is stating only one side of a rather controversial area. The problem, simply equated, would be, how far should the accountant go in the first place in this cost reduction field?

There is a great body of professional accounting people, both in and out of the industrial accounting area, who approve of and document the argument that over and above doing an intelligent, informative and economical job of reporting the salient and valid facts about a company's operations which can be detailed in terms of dollars and cents, the accountant should thereafter keep his peace and enjoy his night's sleep. This premise says that the accountant is responsible for cost control in his own area only. His responsibility for manufacturing, sales and other non-accounting areas is merely a service function, that of furnishing the necessary financial and cost information to those responsible for the other functions so that they can do their own cost reduction work and, consequently, bear their own frustrations if they cannot perform their own jobs adequately.

It appears to me that the frustration that Mr. Miles has detected in his fellow accountants, if it is there at all, is there because of the super-salesmanship of a few dedicated advocates of "controlmanship". These gentlemen have the somewhat novel idea that because the accountant has at his fingertips, usually before anyone else, the flow of operating information which eventually goes to top management, he should capitalize on that position by immediately jumping up and down demanding immediate action to "maximize profits," "increase efficiency," "reduce waste," etc., etc. Soon, if he gets no results, the momentum he has built up pushes him into an acute case of galloping frustration.

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Unfortunately this attitude assumes that only the accounting and financial divisions of a company have intelligent and reasonable men, and that all other operating executives are somewhat misguided children. If we are to assume the opposite, however, i.e., that the managers of the operating divisions are competent people just as devoted to profit-making and just as efficient as the accountant, then we need not worry ourselves unduly about their failure to do what appears to be the immediate answer. At any given moment, they may be aware of things outside the financial aspects of the company's operations which are influencing the problem a great deal more than the cost reduction area which is our exclusive concern.

In the interest of less frustration and more job satisfaction, then, it would seem appropriate for the accountant to sharpen his own capabilities in terms of providing faster, more economical and more meaningful information to top management and to the operating people who need and want it, assist them in understanding the sources and meaning of the information, work with them to project and analyze costs and cost reduction programs and then leave it up to them to implement their own programs.

Beyond These Covers

Books

Preparing the Annual Report

Elizabeth R. Floyd, American Management Association, 1515 Broadway, New York 36, N.Y., Paper bound, 1960, 111 pp., $4.50.

Procedure and practice in developing the contents of company annual reports and issuing them, even to data on number of copies, are treated here with an exceptional combination of comprehensive coverage and particular attention to aspects, e.g., "working up the manuscript," and the inclusion of special exhibits. It may be salutary for the accountant to note extreme inattention to his part in the matter.

Financial Planning for Greater Profits

American Management Association, 1515 Broadway, New York 36, N. Y., Paper bound, 1960, 152 pp., $3.75.

The case material on profit planning, which this text (A.M.A. Management Report No. 44) offers, is centered in a group of three papers discussing the basic components of a plan, its operation and its services in management. There are also, among the dozen papers making up the book as a whole, presentations on long-range planning of capital appropriations, budgetary control and "total financial planning."

Accounting Manual for Export-Import Companies

Jack Goldner, Matthew Bender & Co., Inc., Albany 1, N.Y., Paper bound, 1960, 49 pp., $5.

Narrative text following the course of the operations to be reflected by the accounts, characterizes this manual, rather than lists of accounts or presentation of entries. Attention is given to subdivisions of the field. Explanation of unfamiliar terms (to many readers) is given in a glossary.

Operating Results for Multi-Unit Department Stores

Milton P. Brown & Eleanor G. May, Division of Research, Harvard Business School, Boston 63, Mass., Paper bound, 1961, 71 pp., $3.

Operating ratios presented in the body of this survey report on department stores having more than one location, are preceded by a section on "Current Branch Store Accounting Problems" which includes discussion of five expense distribution methods. The data assembled in the statistical section reflects operations in 1958.

Punched Card Data Processing Annual — Vol. 2

Gille Associates, Inc., Book Tower, Detroit 26, Michigan, 1960, 256 pp., $15.

Consisting mainly of additional case studies in particular areas of data processing, e.g., payrolls and inventory control, this volume supplements contents of the earlier annual and includes an up-to-date "computer guide" and an instructional article on making a data processing feasibility study.

Statistical Analysis

Edward C. Bryant, McGraw-Hill Book Co., 330 West 42nd St., New York 36, N.Y., 1960, 303 pp., $6.50.

As a textbook, this treatment builds up in seven chapters from the topic of probability through "statistical inference" and "analysis of frequencies" to linear regression and correlation. The remaining chapters concern special topics, largely statistical equipment for use in business decision-making, as sampling, statistical quality control and techniques for operating-level problems.

Executive Control

William Travers Jerome III, John Wiley & Sons, 440 Fourth Ave., New York 16, N.Y., 1961, 275 pp., $6.95.

Designed for "executives, management trainees and business students," this volume, to the title of which the words, "the catalyst" are added, stresses performance evaluation as a means. It closes with three "studies in control," portraying approaches taken at duPont, General Electric Co., and Koppers Company.

Encyclopedia of Tax Procedures

Sydney Prevan, Director, J. K. Lasser Tax Institute, Second Edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1961, 1210 pp., $29.50.

Many authors have contributed to this compendious work. The subsections are grouped into main sections on investments, business property, business expenses, corporations, and individuals. Under business, the five subtopics include "How to Get the Maximum Deduction for Repairs," and "Embezzlement and Theft Losses."

Company Giving

Leo J. Shapiro, Survey Press, 814 North Michigan Ave., Chicago 11, Illinois, 1960, 136 pp., $5.75.

Introduced by a "review and evaluation" authored by James C. Worthy, this book reports policy and practice in the making and processing of charitable contributions by commercial and industrial companies. It is based on a study confined to Chicago and its environs but felt to be relevant nationally.

Credit Manual of Commercial Laws, 1961

Jeffrey, Montgomery, Porth and Rovelstad, Editors, National Association of Credit Management, 44 East 23rd Street, New York 10, N.Y., 1960, 734 pp., $12.50.

The 1961 edition of an established manual, this reference work for credit men and others explains, with citation and summary of applicable laws, such topics (to mention one of increasing relevance) as regulations and legal concepts under which export sales are conducted and credit extended. Conditional sales contract, bad check laws and a multitude of like topics are also included.

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